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Geology of

McCubbin, Poisson, and McGillis Townships

(Savant Lake Area)

District of Thunder Bay

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By

W.D. Bond

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(back pocket)

Map 2357 (coloured)–Savant Lake Area, District of Thunder Bay.

Scale 1 inch to ½ mile (1:31,680).

ABSTRACT

McCubbin, Poisson, and McGillis Townships lie astride Savant Lake which is located approximately 160 air miles (260 km) north-northwest of Thunder Bay. Detailed mapping of the 108-square mile (279.7 km²) area was done in 1971.

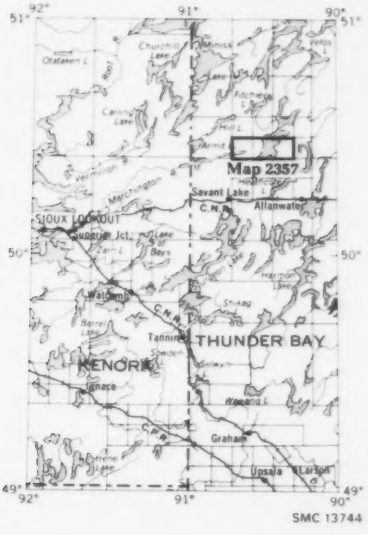

Figure 1–Key map showing location of McCubbin, Poisson, McGillis Townships. Scale 1 inch to 50 miles. (1:3,168,000).

The map-area is underlain by rocks that are Precambrian in age. The oldest rocks in the area are mafic to intermediate metavolcanics located east of Savant Lake, and underlie McGillis Township and part of Poisson Township. These metavolcanics are composed largely of pillow lavas and subsidiary massive flows that accumulated in a subaqueous environment. West of Savant Lake, and underlying part of northern Poisson and McCubbin Townships, are exposed felsic to intermediate metavolcanics consisting predominantly of pyroclastic effusive rocks. The relationship of the felsic to intermediate metavolcanics to the mafic to intermediate metavolcanics is obscured by faulting. Erosion followed this volcanogenic period and formed a proximally derived metaconglomerate. A thick sequence of turbidites was deposited marginal to, and superimposed on the metaconglomerate. During the early history of sedimentation of these finer grained metasediments, iron formation was deposited as integral syngenetic units in the sequence. A few gabbroic sills were intruded. Toward the end of the Early Precambrian, the area underwent a major period of orogenesis, and these rocks were faulted, folded, and metamorphosed with penecontemporaneous intrusion of felsic plutonic batholiths and stocks of various ages. Minor diabase dikes intruded the granitic batholiths during the Late Precambrian. The area was subjected to Pleistocene glaciation, and extensive sandy till was deposited forming various geomorphological features.

In the map-area, gold has been the most important metal to influence the prospecting history, and has initiated two major gold rushes in 1926 and 1941 respectively. The gold is associated with sulphide minerals in secondary quartz veins. The quartz veins are generally discontinuous, and mostly occur along structurally weak zones in the mafic to intermediate metavolcanics, but occasionally occur in the metasediments. These veins are nearly always concordant with the trend of the host rocks. Minor copper sulphide minerals are associated with the mineralized quartz veins. Iron, associated with the extensive iron formation deposits, is the most promising metal discovered in the area so far. In one area in the southwestern part of McCubbin Township, iron formation is present in economically interesting concentrations.

Geology
of
McCubbin, Poisson and McGillis Townships
(Savant Lake Area)
District of Thunder Bay

by

W.D. Bond[1]

INTRODUCTION

During the summer of 1971, the author conducted a geological survey of the area bounded by Latitudes 50°24′N and 50°30′N and by Longitudes 90°17′W and 90°42′W. The area comprises the three townships of McCubbin, Poisson, and McGillis, and covers approximately 108 square miles (279.7 km^2) in the District of Thunder Bay. The townships trend east-west across the central part of Savant Lake, and are situated 160 air miles (260 km) north-northwest of the city of Thunder Bay.

Historically, the Savant Lake area was part of a major thoroughfare linking northwestern Ontario to the Albany River which leads into James Bay, and was travelled extensively by prospectors and trappers. The Savant Lake Greenstone Belt is continuous with the Sturgeon Lake Greenstone Belt which is south of the map-area. Recent major base-metal discoveries in the latter mentioned area have generated new interest in the Savant Lake region. The present mapping program was initiated with the hope of correlating the two volcanic belts.

According to the assessment records (Regional Geologist's Files, Ontario Ministry of Natural Resources, Thunder Bay), intermittent mineral exploration has been carried out since the beginning of the twentieth century when gold and iron attracted the attention of the early prospectors. More recently, base metals have become the main target for exploration companies, but, to date, no major mineral production within the area has been recorded.

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Field Mapping Procedure

Mapping was performed using pace and compass traverses spaced at ¼ mile (0.4 km) intervals, supplemented by vertical air photographs (scale 1 inch to ¼ mile; 1:15,840). Traverses were designed to visit as many outcrops as possible, which had been previously interpreted by examining air photos and were set up, where possible, at or near right angles to the known trend of the rocks. Where outcrop was plentiful, mapping was done by using air photos to locate individual exposures without using pace and compass methods. Topographic features recognizeable on air photos and on the ground were used to plan traverses. Also, all shorelines of lakes, rivers, and all roads were examined for outcrops. Standard compasses were useless in most of Poisson and McCubbin Townships owing to the underlying extensive magnetic iron deposits. Consequently, the strikes of the planar structures in this part of the map-area were obtained by using the sun and/or the topography (the shape of the exposure if observable on the accompanying air photo). Error in measurement of strike is estimated to be no more than ±5°. Geological data were plotted on transparent overlays attached to the air photographs, and subsequently were transferred to a base map prepared by the Cartographic Section, Ontario Division of Lands, from map-sheets of the Forest Resources Inventory of the Ontario Division of Forests, Ministry of Natural Resources. Mapping emphasis was placed on the metavolcanic-metasedimentary rocks, and the granitic areas were less extensively examined.

Preliminary uncoloured geological maps, P.722, P.723, P.724 (Bond 1972a,b,c) supplemented with marginal notes were published on a scale of 1 inch to ¼ mile (1:15,840) and issued early in 1972.

Acknowledgments

Field work was aided by P. Rae Teal, who acted as senior assistant, and by A.I. Burnett, F.R. Ploeger and G.C. Sharpe who acted as junior assistants. A.I. Burnett and F.R. Ploeger also performed some independent mapping.

Mr. R.J. Shegelski of the University of Toronto provided several additional top determinations in the metasedimentary units near the Savant Lake Fault in Poisson Township, and aided the author in locating the minor synclinal and anticlinal fold axes that trend parallel to the fault.

Mr. P.F. Leahy, geologist for the Algoma Steel Corporation Limited, provided detailed company maps on a small part of Poisson Township. Dr. R.G. Walker of the Department of Geology, McMaster University,is also to be thanked for several discussions during the field season. Special thanks are extended to Mr. and Mrs. D. Steinbrook and Mr. and Mrs. C. Sawyer, owners of the two resort camps in Poisson Township, for their hospitality and the general information they gave about the area. Ignace Airways based in Ignace, 90 miles (145 km) to the south, provided excellent air service during the field season.

Means of Access

The centre of the map-area is approximately 18 miles (30 km) northeast of the town of Savant Lake which is situated at the junction of the Canadian National Railways and Highway 599. Highway 599, which connects Ignace, Savant Lake, and Pickle Crow passes through McCubbin Township (see Figure 1). Access in to Savant Lake is possible by fixed-wing aircraft from the towns of Savant Lake, Sioux Lookout, or Ignace, or by all-terrain vehicle along two winter roads north of the town of Savant Lake. These two roads lead to, and are maintained by, tourist lodges. The more southerly route can be used by motor car for the first 1.5 miles (2.4 km) or until the small unnamed lake in southeastern McCubbin Township is reached. Thereafter, like the more northerly route, only all-terrain vehicles can be used. The northern route is more inaccessible; it is 5¾ miles (9.2 km) long, and vehicles attempting this route must have a very high ground clearance.

Except for the northwestern corner of McCubbin Township, the numerous lakes and streams afford easy access by canoe into most parts of the map-area. The majority of the portages are well cut, and are used extensively by the hunters and fishers that visit the tourist lodges.

Inhabitants

The town of Savant Lake has a railway station, general store, hotel, and post office. The year-round population of the town fluctuates, but averages about 200 people.

Besides the tourist lodges, the only permanent inhabitants in the area are an Indian family at the junction of Highway 599 and Wiggle Creek.

Previous Geological Mapping

According to Moore (1928), the first reference to Savant Lake in the literature was by McInnes (1901) who reported traces of gold occurring on one of the islands in Savant Lake. Gibson (1902) and Miller (1903) also reported gold-bearing quartz veins in the area. Collins (1910), the first to conduct a geological reconnaissance of the area, published a map (Map 993) at a scale of 1 inch to 4 miles (1:253,440). The area was brought into prominence by a major gold rush in 1926. As a consequence of this, in the following year, Moore (1928) made the most detailed study of the region to that date, publishing a map (Ontario Department of Mines Map 37j) at a scale of 1 inch to 2 miles (1:126,720). Although the survey was reconnaissance in nature, the distribution of his lithologies was found to be accurate, and proved to be of great assistance during the present field mapping. The most detailed study of the map-area to date was done by Rittenhouse (1936) who mapped McCubbin and Poisson Townships, and the other two townships immediately to the south, Conant and Jutten Townships respec-

tively, as well as working on a Ph.D. thesis. This mapping was compiled by Satterly (1941) on a map at a scale of 1 inch to ½ mile (1:31,680). The Ontario Division of Mines (Davies *et al.* 1970) published a 1 inch to 4 mile (1:253,440) compilation map of the Sioux Lookout–Armstrong (Ontario Division of Mines Map No. 2169) region which encompasses the Savant Lake area, and more recently Skinner (1969) also mapped the area at a reconnaissance scale (1 inch to 4 miles; 1:253,440) for correlation with the surrounding volcanic belts.

Prospecting and Mining Activity

Intermittent mineral exploration has been going on in the Savant Lake area since the turn of the twentieth century when gold attracted the attention of the early prospectors. Interest in the area was enhanced, when, a few years later, extensive iron deposits were discovered to the west of Savant Lake. Moore (1910) made a survey of the iron deposits and reported them to be of fairly low grade. A magnetic survey was also made over Kashaweogama Lake for the Ontario Bureau of Mines during the spring of 1920 (Assessment Files Research Office, Ontario Division of Mines, Toronto, File 63.2932). Most of the iron deposits were found to be concentrated south of Kaskaweogama Lake in the extreme southwestern corner of McCubbin Township, and were also described in the report of the Ontario Iron Ore Committee (1923). No iron production has been attempted to date.

In 1926, the first significant gold discovery in the area was made by a group of prospectors on a small island in Savant Lake. This discovery became known as the McRae-Simmons Property (see section on "McRae-Simmons Occurrence") and is described by Moore (1928,p.76-77). During 1940, the area was again brought into prominence when favourable assays for gold in samples taken from a prospect just west of Savant Lake initiated another gold rush and extensive staking was done. The initial discovery was made by Northern Canada Mines Limited and was well documented in the September issues of the Northern Miner (Northern Miner 1940a,b,and c) that same year. Both these gold discoveries have proved to be uneconomic to date.

Since the mid 1950s emphasis in exploration has shifted from precious metals to base-metal deposits. With the discovery of the Mattabi copper-lead-zinc-silver Mine on Sturgeon Lake in 1968, exploration activity has increased considerably in the Savant Lake region from 1969 to the present day.

Topography and Drainage

The map-area is separated into two major drainage basins by a great divide which passes between Whimbrel Lake and Savant Lake; the early geological reports including Moore's (1928) report and the local residents refer to Whimbrel Lake as Iron Lake. The area east of Whimbrel Lake drains to the northeast, and is part of the Albany River Drainage Basin which eventually flows into James Bay. West of, and including Whimbrel Lake, all rivers and lakes drain westward,

and are part of the English River Drainage Basin. For the most part, the gradients are gentle; only rarely do rapids occur. Many of the rivers are small, choked by overhanging trees, and are not traversable by canoes. Portages into many of the smaller lakes are numerous and well maintained.

The elevation of Savant Lake fluctuates about the 1,306-foot (397.0 m) mark above mean sea level. The surrounding terrain averages 50 to 75 feet (15 to 22.9 m) above this lake level and rises locally to a maximum of 1,500 feet (460 m) above mean sea level. The entire area has been glaciated, with the result that many of the lakes are aligned with the general direction (south-southwest) of ice movement. Glacial deposits are extensive, and the topography appears not to be strongly influenced by the underlying bedrock. Moderately sized swamps and muskegs are common, especially in McGillis Township. Generally, the topography is fairly flat, except where it is broken by morainic ridges similar to those which occur between Whimbrel Lake and Savant Lake.

Outcrop density is sporadic, and variable in amount. Frequently, patches of well-exposed rock are surrounded by areas of almost no outcrop. The shoreline of Savant Lake and the numerous small lakes have excellent exposures. Outcrops of mafic to intermediate metavolcanics to the east of Savant Lake are generally covered with a thick blanket of moss, are well rounded and have moderate relief. The metasediments and felsic to intermediate metavolcanics form generally low, flat-lying exposures with little or no moss cover.

Natural Resources

The area is densely covered by a mixed growth of spruce, pine, poplar and balsam, as well as some minor areas of birch and elm. Tamarack occurs locally. Cedar is confined to the low wet areas, and along the higher rocky cliffs on the east side of Savant Lake. Juniper and blueberries are plentiful in the warm, dry areas. Red pine and jackpine are found locally, being mainly associated with the high dry sandy areas. In general, the deciduous trees are more prolific west of Savant Lake. The area south of Kashaweogama Lake has been extensively timbered out by the Great Lakes Pulp and Paper Company during 1970-1971.

Game fishing attracts many tourists to the area. There are three tourist camps on the lake; two are situated three-quarters of the way up the western shoreline of Savant Lake in Poisson Township (see Map 2357, back pocket) at the termination of the bush trail leading off from Highway 599 at mile 20 (km 32). The other is located south of the map-area at the end of the road that joins Highway 599 at mile 16 (25.7 km). Pike and pickerel thrive in all areas of the lake. The Narrows, located at the junction of the main part of Savant Lake and the South Arm of Savant Lake is noted for its excellent fishing. Lake trout are found in the deepest portions of the lake, one of which occurs in the South Arm of Savant Lake, south of the narrows.

Bear and moose are plentiful, and attract many hunters to the area in the fall. Muskrat, beaver, otter, rabbit, ground hog, squirrel, and smaller rodents are also present.

GENERAL GEOLOGY

Regional and detailed mapping have established that all the consolidated rocks are Precambrian in age. Previous surveys (Moore 1928; Rittenhouse 1936; Skinner 1969) have all concluded that the structure of the map-area is dominated by a synclinal fold in the metavolcanic-metasedimentary sequence. The compilation of reconnaissance and detailed mapping to date (Davies *et al.* 1970) of the area shows a rather simple geological pattern with mafic to intermediate metavolcanics forming the base of the 'Savant Lake sequence', overlain in turn by metasediments and felsic to intermediate metavolcanics. The entire metavolcanic-metasedimentary succession appears to be folded about a northeast-trending axial trace, and is bounded by large areas of granitic batholiths. The map-area contains only the lower metavolcanic sequence and the overlying metasediments. The rock types exposed in the area are given in Table 1.

Mafic to intermediate metavolcanics form the base of the sequence, and may be as much as 30,000 feet (9000 m) thick. Pillow structures are abundant in the flows and indicate that the rocks of this basal unit were deposited in a subaqueous environment. Felsic to intermediate metavolcanics overlying the mafic to intermediate metavolcanics are composed largely of a heterogeneous accumulation of medium- to coarse-grained pyroclastic material. North of Wiggle Creek these rocks form a succession that may be up to 11,000 feet (3300 m) thick.

TABLE 1 TABLE OF LITHOLOGIC UNITS FOR McCUBBIN, POISSON AND McGILLIS TOWNSHIPS.

PHANEROZOIC
CENOZOIC
QUATERNARY
RECENT
Swamp and stream deposits (unconsolidated)
PLEISTOCENE
Silt, sand, gravel and boulders (unconsolidated)

UNCONFORMITY

PRECAMBRIAN
LATE PRECAMBRIAN
MAFIC INTRUSIVE ROCKS
Diabase[b]

INTRUSIVE CONTACT

EARLY PRECAMBRIAN (ARCHEAN)
FELSIC INTRUSIVE ROCKS
MASSIVE FELSIC INTRUSIVE ROCKS
Porphyritic granodiorite; granodiorite, quartz monzonite; aplite dikes

INTRUSIVE CONTACT

FOLIATED FELSIC INTRUSIVE ROCKS
Granodiorite to quartz monzonite, granodiorite to quartz monzonite with biotite-rich xenoliths, hybrid granitic rocks

Table 1 - continued

INTRUSIVE CONTACT

METAMORPHOSED FELSIC INTRUSIVE ROCKS

HERON LAKE STOCK

Trondhjemite; quartz-rich trondhjemite; quartz-poor trondhjemite; quartz, quartz-feldspar porphyry[b]

INTRUSIVE CONTACT

MAFIC INTRUSIVE ROCKS

Metagabbro[a]; metadiorite[a], porphyritic metagabbro[ab]

INTRUSIVE CONTACT

METASEDIMENTS

ARENACEOUS METASEDIMENTS

Greywacke, siltstone; tuffaceous metasediments; siliceous sandstone, in part tuffaceous metasediments, subgreywacke sandstone

FERRUGINOUS METASEDIMENTS

Greywacke, subgreywacke and sandstone; siltstone; quartz-magnetite iron formation; tuffaceous metasediments; jasper chert-magnetite iron formation

CONGLOMERATIC METASEDIMENTS

Polymictic orthoconglomerate with metavolcanic clasts; polymictic granitoid boulder-bearing orthoconglomerate

FAULT CONTACT

METAVOLCANICS

FELSIC TO INTERMEDIATE METAVOLCANICS

Rhyodacitic to rhyolitic metavolcanics; dacitic to andesitic metavolcanics; tuff; lapilli-tuff; tuff-breccia to agglomerate; fine-to medium-grained flows, porphyritic flows; quartz-carbonate schist; reworked tuff

MAFIC TO INTERMEDIATE METAVOLCANICS

Chloritic metavolcanics; actinolitic metavolcanics, pillowed lavas; pillow breccia; flow-top breccia; fine-to medium-grained flows[c]; crystal tuff; iron formation; volcanic conglomerate; variolitic flows

a - occurs as small dikes or sills
b - occurs as small dikes only
c - may be intrusive in part
d - may be extrusive in part

Metasediments consist of two types of metaconglomerate overlain by a thick sequence of greywacke-sandstone, siltstone and cherty metasediments. Iron formation is intimately mixed with the metasediments and forms discrete units. Minor gabbroic sills were intruded into the metasediments.

Felsic intrusive rocks underlie 15 to 20 percent of the map-area. The rocks of this category were subdivided by the author on the basis of texture, amount of metamorphic alteration, and size of the intrusions. A few Late Precambrian diabase dikes were intruded into the granitic rocks.

Folding is more evident in the metasediments than in the metavolcanics. Faulting is generally in a northeasterly direction.

The metavolcanics and metasediments have been metamorphosed to the greenschist facies rank regionally, and to amphibolite facies rank near the larger bodies of felsic intrusive rock.

The Aeromagnetic Maps (ODM-GSC 1961a,b) show very high magnetic intensities over much of the area that are caused by the extensive presence of magnetite-bearing iron formation which tends to mask other geological trends.

Earlier workers (Moore 1928; Rittenhouse 1936; Skinner 1969) established the main lithologic units and set up their own nomenclature for the formations. Table 2 summarizes the main stratigraphic sequence and the terminology used by each of these geologists. The terminologies are all largely based on the conclusion that the area is dominated by a single major synclinal fold. In fact, evidence from the present mapping indicates the following: folding in the area is complex; a broad range in age of felsic intrusive rocks probably exists extending possibly from the time of the earliest supracrustal rocks; and that establishment of a formal stratigraphic legend would be premature at this time of writing. The scheme used in this report is therefore based on an informal lithological grouping and is only grossly stratigraphic.

Precambrian

EARLY PRECAMBRIAN (ARCHEAN)

Metavolcanics

The metavolcanics were subdivided by the author into two main categories: (a) mafic to intermediate metavolcanics, and (b) felsic to intermediate metavolcanics. Mafic to intermediate metavolcanics which were mapped in the field as such have a colour index greater than about 30 percent. Metavolcanics with less than 30 percent mafic minerals were designated to have a felsic to intermediate composition. Most of the mafic to intermediate metavolcanics east of Girard Island (in southeastern Poisson Township and western McGillis Township) are mafic in composition, and have a colour index greater than 40 percent. A thin band of metavolcanics with flows and pyroclastic rocks occurring along the north arm of Whimbrel Lake between the felsic to intermediate metavolcanics and the

TABLE 2 | HISTORY OF STRATIGRAPHIC NOMENCLATURE USED FOR SAVANT LAKE AREA.

Moore, E.S. (1928)	Rittenhouse (1936)	Skinner (1969)	Present Survey
PRECAMBRIAN:			
KEWEENAWAN: Diabase dikes	KEWEENAWAN (?) - Diabase dikes	KEWEENAWAN (?) - Diabase dikes	LATE PRECAMBRIAN - Diabase dikes
ALGOMAN: Granitic Intrusives	Granitic Intrusives	Granitic Intrusives; gneisses	FELSIC INTRUSIVES
	BASIC INTRUSIVES		MAFIC INTRUSIVES
	HANDY LAKE VOLCANICS	HANDY LAKE VOLCANICS	METASEDIMENTS
	unconformity		
TIMISKAMING: Complex series of interbanded acid, intermediate and basic lava flows, agglomerates, tuffs, arkoses, greywacke, banded iron formation and conglomerate and derived gneisses.	SAVANT SERIES — UPPER: Upper Greywacke member; Upper Iron-bearing member; Lower Greywacke member; Lower Iron-bearing member	SAVANT GROUP: TIMISKAMING (?) Metasediments; Pyroclastics	Arenaceous Metasediments; Ferruginous Metasediments; Conglomeratic Metasediments
SAVANT GROUP	SAVANT SERIES — LOWER: Upper Conglomerate member; Lower Conglomerate member	SAVANT GROUP	Felsic to Intermediate Metavolcanics
KEEWATIN: Greenstones, intermediate to mafic metavolcanics	JUTTEN VOLCANICS: Mafic to intermediate metavolcanics	GREENSTONE: Mafic to intermediate metavolcanics	MAFIC TO INTERMEDIATE METAVOLCANICS

base of the metasediments in McCubbin and Poisson Townships is intermediate in composition, but is also partly mafic. These rocks, therefore, were included in the mafic to intermediate metavolcanics.

An attempt was made to further subdivide the intermediate to felsic metavolcanics into: (a) andesitic to dacitic varieties (colour index 20 to 30), and (b) rhyodacitic to rhyolitic metavolcanics (colour index less than 20).

MAFIC TO INTERMEDIATE METAVOLCANICS

The mafic to intermediate metavolcanics (see Table 2) were formerly classified as part of the Savant Group by Moore (1928). Rittenhouse (1936) remapped the area and further subdivided the rocks, applying the name 'Jutten Volcanics' to the mafic to intermediate metavolcanics because of their excellent exposure in Jutten Township to the south of Poisson Township. Skinner (1969) dropped the term 'Jutten Volcanics' and referred to them simply as greenstone.

These rocks constitute about 55 percent of the map-area and are confined essentially to two areas. The first area includes the greater part of McGillis Township, and the eastern part of Poisson Township. In these townships, the mafic to intermediate metavolcanics curve around the felsic intrusive rocks in the eastern part of McGillis Township, and trend from N80°E in the southwest to N35°E in the northern part of McGillis Township. Mafic to intermediate metavolcanics are also found to underlie the northern part of McCubbin Township, and exhibit a gently curvilinear concave pattern facing north. In addition, mafic to intermediate metavolcanics form small lenses at the contact between the metasediments and felsic to intermediate metavolcanics that extends along the north arm of Whimbrel Lake towards Savant Lake.

The mafic to intermediate metavolcanics have a basaltic to andesitic composition. Within this group, pillowed lavas and subsidiary fine- to medium-grained massive flows of similar composition predominate. Locally, pillow breccia, flow-top breccia, amygdaloidal flows, porphyritic flows, volcanic conglomerate, lapilli-tuff, tuff-breccia, crystal tuff, variolitic flows, and metasedimentary iron formation are present. Associated with the above rocks are amphibolites and chlorite schists.

In the field these rocks exhibit a wide variation in colour and texture. As a rule, the variation displayed can be attributed to changes in mineral assemblages arising from metamorphic alteration and/or local shearing. Except for the common development of amphibole (amphibolitization) near the contacts of felsic plutonic rocks, most of the colour and textural variations are non-systemic, and cannot be distinguished to form mappable units. Amphibolitization of mafic to intermediate metavolcanics near granitic intrusive rocks is accompanied by general darkening of the rock to a green-black colour. Away from these amphibole-rich contact zones, the mafic to intermediate metavolcanics weather from a creamy yellow-green in highly carbonatized and epidotized rocks to dark green where chlorite and amphibole are extensively developed. Between these extreme colours all possible variations were noted in the field. Fresh surfaces vary from light to grey-green to dark green, and tend to be darker than the weathered surfaces. The massive flows are generally slightly darker green on both the weath-

ered and fresh surfaces than the pillowed lavas. In the field-mapping an attempt was made to subdivide the rocks into light green metavolcanics (code 1a, Map 2357, back pocket) characterized by chlorite and tremolite, and dark green metavolcanics (code 1b, Map 2357, back pocket) characterized by the development of actinolitic and hornblendic amphiboles.

Metamorphism is predominantly greenschist facies rank and primary structures are well preserved in the mafic to intermediate metavolcanic sequence. Pillow lavas are the most abundant rock type, and Rittenhouse's original estimate that they constitute 85 percent of the succession of mafic to intermediate metavolcanics is reasonable. From the present survey these rocks are estimated to form about 75 percent of the rocks underlying McGillis Township, and about 70 percent of the sequence underlying McCubbin Township. Pillow lavas are best exposed on the eastern shore of Savant Lake and on several islands in Southeast Bay. Weathered surfaces vary from creamy yellow-green along the northern shore of the peninsula that separates Southeast Bay and Savant Lake to dark green on the eastern shore of Savant Lake. Typically, the individual pillows have light green weathered margins becoming progressively darker towards the interior of the pillows. The selvages of the pillows tend to be light yellow-green, while the adjacent matrix is dark green. The matrix often weathers out, especially in the shoreline exposures.

Pillows vary in size and form. The majority of the pillows are closely packed with a minimum of interstitial material. Locally, there are irregular patches up to 1.5 feet (0.5 m) wide where the matrix is more abundant, and in some places these are filled with secondary quartz. Individual non-distorted pillows vary in length from a minimum of 3 inches (7.6 cm) up to a maximum of 15 or 20 feet (4.5 to 6 m) but average 5 feet (1.5 m).

The thickness of the pillows varies from 3 inches (7.6 cm) to 4 feet (1.2 m) and averages 2 feet (0.6 m). The smaller pillows (less than 6 inches (15 cm) across) tend to be more or less spherical in shape. On any given exposure there is no regularity in the size of pillows and commonly,very large pillows are found wtih very small pillows. The ratio of length to thickness of the pillows ranges from 1:1 to a maximum of 15:1 in zones of intense shearing. Non-distorted pillows have an average length to thickness ratio of 3:1.

Two varieties of pillows based on form were noted during the field mapping. The first type is shown in Photo 1 and has the classic shape in which individual bun- to loaf- to mattress-shaped pillow lavas are entirely separated from each other by a minimum amount of intervening matrix material. The second type is much less common and is shown in Photo 2; it consists of individual masses of pillow lava joined together by narrow necks. This latter type is further characterized by (1) the presence of a substantially greater volume of matrix and, (2) the pillowed lava masses are highly irregular in form owing to primary plastic deformation. Many pillows of this second type have re-entrant selvages implying they have been rolled before consolidation. The second type (joined pillow masses) are roughly linear in form, although a few were found joined to the underlying and/or overlying pillowed masses. Several connected pillow forms were found extending for an exposed maximum length of 20 feet (6 m). Lack of exposure prevented tracing further the continuity of the joined pillows. It is possible that some of the connecting links between pillows were just not exposed on the present erosional plane.

ODM9494

Photo 1–"Classic-shaped" pillow lava from small island in northwestern McGillis Township.

If both types of pillow forms occur in a single exposure, they are chaotically distributed, making it impossible to distinguish the two. Connected pillows are mainly found in the islands in Savant Lake and on the central-eastern shore of Savant Lake (in northwestern McGillis Township).

Individual pillow forms (type 1, see Photo 1) probably have a 'classical' origin where discrete masses of lava completely separated from their source vent were deposited on the sea floor moulding themselves to those that have gone before. Probably some rolled down the side of a vent which would explain the reentrant selvages. The mechanism of formation of the connected pillows (type 2, see Photo 2) is more controversial. Jones (1968) described pillows of similar form from Iceland and Wales, he attributed their growth to a "process of formation and propagation analgous to the digital advance of slow-moving pahoehoe flows." Macdonald (1953, p. 172) described the process for the pahoehoe flows:

ODM9495

Photo 2–Irregular pahoehoe-type pillow lavas showing connecting links between individual masses of lava. Taken on eastern shore of Savant Lake, pencil is about 8 inches (20 cm) long.

The entire front advances by successive protrusion of one small bulbous toe after another. Most toes advance only a few feet before they chill to immobility, after which the skin of the flow ruptures at some other point and another toe is sent out.

Some toes extend themselves by a process of inflation, the skin remaining unbroken, or if broken, quickly sealed again by lava.

Johnston (1969) discounted this method of pillow propagation, claiming that the classical origin is much more logical in explaining Early Precambrian pillow lavas mainly because: (a) connected pillows are very rare in the Early Precambrian; (b) there is no evidence of depletion of magma of one pillow form in sympathy for the adjacent pillow form; and (c) the regularity of primary features in most pillowed areas indicated (Johnson 1969):

a definite and fixed relationship between adjacent pillows implying orderly advancing flows are involved unlike the budding process which would be expected to produce a more haphazard arrangement.

McBirney (1971) also noted the close resemblance in form of subaerial pahoehoe lavas and some pillowed lavas, and in cases has found it to be almost impossible to distinguish the two. Connected pillow masses of haphazard form do exist in the map-area at Savant Lake. The author believes that a mode of for-

mation for pillows similar to that postulated by Jones is the most reasonable.

The pillow lavas are apparently non-vesicular, massive, and fine to medium grained. The lack of amygdules and/or vesicles may be caused by: (a) the vesicles being destroyed during later regional deformation especially if they were never filled (to become amygdules) or (b) the vesicles never formed. According to Walker (1960), filling of vesicles (formation of amygdules) takes place quite readily during the earliest stages of metamorphism. The author agrees with Ayres (1969) who argued that other primary structures and textures have survived greenschist facies metamorphism, and there is no reason why amygdules should not also survive.

Therefore, it is concluded by the author that vesicles were probably never present in these rocks. The relation of abundance and size of vesicles in pillowed lavas to the depth below water level of extrusion has been documented by Moore (1965) near Hawaii and Jones (1969) near Iceland. Moore (1965) and Jones (1969) found that the size and population of vesicles decreased systematically with increase in depth of water. Vesicles were found to be almost non-existent at depths greater than 4000 m (13,000 feet) below sea level. Engel and Engel (1966) report alkali-rich basalt that is vesicular at a depth of 3300 to 4500 m (10,800 to 14,800 feet) below mean sea level. Their study also showed alkali-rich basalts of seamounts near Hawaii contained more and larger vesicles than did those of nearby tholeiitic basalts of equal depth, and concluded that the magma type is also a factor in vesicle formation. Ayres (1969, p.30) stated that vesicle formation depends upon:

(1) The amount of water in solution in the magma.
(2) The solubility of water in the magma.
(3) The temperature of the magma.
(4) The composition of the magma.
(5) The degree of crystallinity.

Obviously, a number of variables was involved in vesicle formation, but depth of extrusion beneath water was probably a major factor and the author concludes that the pillow lavas of Savant Lake were extruded in fairly deep water.

Although many of the pillows appear plastically deformed in part, pillow-breccia was encountered at only two localities. The most spectacular occurrence (Photo 3) is situated in a small bay on the eastern shore of Savant Lake halfway up the Poisson-McGillis township boundary. This is undoubtedly the rock to which Moore (1928, p. 59) referred to in his report as being the "peculiar lava structure". The other locality of pillow breccia is very small (14 feet thick; 4.3 m) and occurs on one of the small islands of Savant Lake in northwestern McGillis Township. Most of the light coloured fragments show only fractions of chilled rims, are widely spaced and disaggregated; the form can be classified as "broken pillow breccia" (Carlisle 1963).

The concentric structures that Moore (1928, p.59) noted in some of the pillows were not observed during the mapping.

Massive flows are intimately associated with the volcanic pile. They are generally darker, slightly coarser in texture than the pillow lavas, and are relatively featureless rocks. Their stratigraphic relation to the pillow lavas is best exemplified on the shoreline exposures in Southeast Bay. The flows have a variable thickness (1 foot to 100 feet; 0.3 to 30 m), and thicken, and thin in direct relation

ODM5496

Photo 3–Broken pillow breccia from the small bay on the eastern shore of Savant Lake midway up the Poisson-McGillis township line.

to the thickness of the associated pillow lavas. Many are discontinuous and are traceable with assurance for only short distances. From dredging along the mid-Atlantic ridge, Melson *et al.* (1968) concluded that many thick basaltic lava flows are pillowed on their outer margins, but have massive interiors, although the massive interior might also be formed of intrusive rocks. The same relation undoubtedly exists in the mafic to intermediate metavolcanics. The thicker flows may be multiple; exposed contacts are extremely rare. A contact between pillow lavas and a massive flow exposed on the small island just west of the Pride Lake portage is marked by a progressive, but fairly abrupt decrease in grain size accompanied by a darkening in colour. The actual contact is sheared, and pitted, and injected with quartz stringers. Several coarse flows in the Southeast Bay area are bordered by finer grained phases of significant thickness and the latter may represent either chilled margins or separate flows. A brecciated flow top (Photo 4) was observed only once at the contact of felsic to intermediate metavolcanics (to the north) and an intermediate, porphyritic, in part amygdaloidal flow (to the south). This exposure is at the first outcrop on the western side of Highway 599 at the beginning of the sharp right-hand bend in the road in central McCubbin Township. The contact relationship between the two flows is somewhat unclear because of the lack of exposure, but tops appear to be to the south.

Several flows in the area differ from those previously described. In McGillis Township west of Elga Lake and striking along Virginian Lake, there is a unique rock that is described as having a "coarse knobby texture" on the preliminary map of McGillis Township (Bond 1972c). This term was applied to describe the presence of coarse-grained amphibole crystals throughout the rock which are more resistant to weathering, and stand out ¼ to ½ inch (0.6 to 1.3 cm) above the surrounding groundmass. Forming a distinct, mappable, concordant layer, the

ODM9497

Photo 4–Brecciated flow top between two massive metavolcanic flows. Photo taken on the first exposure on the western side of Highway 599 at the sharp right-hand bend in central McCubbin Township.

massive flow, which is probably composed of multiple flow units, varies in thickness from 1,000 to 1,500 feet (300 to 460 m), and is traceable more or less continuously for 3.5 miles (5.6 km). Its trend is curvilinear, having being deflected by the granitic intrusive at Elga Lake. The rock is typically green-black on both the weathered and fresh surfaces. The stubby amphibole crystals, which form 50 to 70 percent of the rock vary from ⅛ to ½ inches (0.32 to 1.3 cm) in cross-section; the crystals plunge steeply, are locally lineated and sheared, and are regularly spaced at intervals of 0.06 inch to ¼ inch (1.6 to 6 mm). Thin section examination shows the amphiboles to be roughly square to subrounded crystals of actinolite (2.5 to 5 mm; 0.16 to 0.2 inch). The actinolite exhibits undulatory extinction, and is fractured, having undergone strain probably related to intrusion of the nearby granitic intrusive rocks. The actinolite is uralitic and is rimmed by metamorphic hornblende. The matrix consists of equal amounts of subhedral hornblende prisms and actinolite (up to 1 mm in length), prograding chlorite and granular plagioclase (probably oligoclase). Sphene and carbonate are minor accessories. The nature of the amphiboles infers that this rock is probably a metamorphosed porphyritic flow of basaltic composition in which actinolite is pseudomorphic after pyroxene. No cross-cutting relationships were observed in the field but it is also possible that this coarse-grained "knobby" unit may be intrusive.

ODM9408

Photo 5–Porphyritic anorthositic gabbro on islands adjacent to the east-central shore of Savant Lake.

The author believes that the texture in the rock is not metamorphic but primary because of the near equidimensional outline of the actinolite crystals, the fact that they are single crystals and not crystal aggregrates, that they are actinolite (which commonly forms as pseudomorphs), and because of the relatively low metamorphic rank (upper greenschist facies) of the rock.

Porphyritic mafic to intermediate metavolcanics in the map-area contain fine- to coarse-grained (gabbroic) sills or dikes regularly spotted with subrounded feldspar phenocrysts and/or crystal aggregates (Photo 5). This texture is found at several locations in McGillis Township:

(1) Between Virginian and Elga Lakes.

(2) South of Virginian Creek between Leggo and Pride Lakes.

(3) Along several islands just west of the east central shore of Savant Lake.

(4) Locally between the northern part of Silver Lake and Pride Lake.

(5) On the east shore of Silver Lake near the outlet of Virginian Lake.

The most spectacular porphyritic sill is situated between Virginian and Elga Lakes. There, the porphyritic rock forms a sill-like body approximately 75 feet (22.8 m) in width which can be traced discontinuously for 1.5 miles (2.4 km). In its southern reaches it appears to be concordant but, in the north, it is observed

to swing sharply towards, and is truncated by, the Elga Lake Pluton. The surrounding host rocks are massive, and featureless, and it is difficult to determine the true relationship of the porphyritic sill-dike to them. The porphyritic rock is charged (40-65 percent) with fairly regularly spaced, subrounded, single plagioclase crystals varying from ¼ inch (6 mm) up to 1.5 inches (3.8 cm) and averaging ¾ inch (1.9 cm) in length. A few of the plagioclase phenocrysts are observed to be twinned. The margins of the plagioclase phenocrysts are generally smooth, rounded, and remarkably sharp; only rarely are the margins fractured. A few of the phenocrysts are ellipsoidal with a length to width ratio of 2:1 and, where shearing is present, these elliptical crystal aggregates are roughly aligned. The matrix has a gabbroic texture and composition, and is not so thoroughly recrystalized as the surrounding country rocks. This may be caused by the original coarser grain size of the rock; that is, the country rocks are finer in grain size and are more readily susceptible to metamorphic alteration. In thin section, the plagioclase phenocrysts are highly altered to saussurite, sericite and carbonate. One thin section of a sample taken from the exposure, 3,700 feet (1100 m) north of Elga Lake that is apparently not part of the main porphyritic zone, was unaltered. In this thin section, the large plagioclase phenocrysts were found to be bytownite (An_{74}), while the matrix plagioclase was determined to be labradorite (An_{62} to An_{68}). In general, the matrix consists of equal amounts of plagioclase and tremolite that have been recrystallized to varying degrees. In a few thin sections, the matrix plagioclase is only slightly recrystallized while the coarse plagioclase phenocrysts were highly altered. This may be a reflection of a higher anorthite content in the latter. Matrix material has crystallized along microfractures which cut the grains of porphyritic plagioclase. A few fragments that have been broken off the edges of the plagioclase phenocrysts are found enclosed in the adjacent matrix, and are evidence of deformation of the phenocrysts prior to crystallization of the matrix.

The other occurrences of porphyritic mafic metavolcanics are similar to the above occurrence, differing only in their gross field relations and in the fact that their matrix is finer grained. The grain size of these porphyritic units is similar to that of the pillow lavas and mafic flows found throughout the mafic metavolcanic sequence. Approximately 430 feet (130 m) south of Virginian Creek, leading into Southeast Bay, a porphyritic unit 50 feet (15 m) thick can be traced for approximately 1,500 feet (460 m). Field relations show that the porphyritic zone is stratigraphically overlain by pillowed lavas (tops to the north) and underlain by 300 feet (90 m) of massive, fine- to medium-grained, multiple flows which in turn overlie pillow lavas. The matrix here differs from the matrix of the porphyritic sill or dike between Virginian and Elga Lakes because it is composed predominantly of actinolite (75 to 80 percent), the remainder of the rock is plagioclase. At location (4), (between Pride and Silver Lakes) the porphyritic gabbroic rock appears to be in the central part of a flow. The matrix of the porphyritic part is coarsest with grain size decreasing to the margins which are devoid of phenocrysts.

The stratigraphic association of these porphyritic rocks suggests that two mechanisms may be instrumental in their origin. Baragar (1960) described rocks of similar texture in Labrador and described them as "leopard" rocks. Baragar found the "leopard rock" sills to be commonly bordered by zones which are devoid of the porphyritic plagioclase, but are of similar gabbroic composition to

that of the matrix of the porphyritic rock. Baragar appealed to a "flow differentiation" mechanism whereby the plagioclase crystals are concentrated into the faster flowing central regime of flowing magma if the magma is intruded into a narrow restricted passage. This process was shown by Battacharjii (1967) to be experimentally reproduceable. Chemical analysis of a representative sample of the porphyritic mafic metavolcanic flow of Virginian Lake (Table 3, analysis 1) shows these rocks to be similar in composition to the "leopard rocks" in Labrador (see analysis A.177, p.1,634, Baragar 1960). Abrasive interaction between the crystals and/or crystal aggregates could cause the rounding. The apparent concentration of plagioclase phenocrysts at the top of the flow situated south of Virginian Creek (between Leggo and Pride Lakes) suggests the porphyritic plagioclase may have crystallized *in situ* and risen to the top as the lighter fraction in a manner similar to the sills in Minnesota described by Phinney (1969).

Thus, the relative position occupied by the plagioclase phenocrysts within the mafic metavolcanic sills of Savant Lake would seem to determine which process may have been operative. The concentration of phenocrysts in the central part of some of the flows supports Baragar's (1960) "flow differentiation" mechanism while the concentration of phenocrysts towards the margins and the upper or lower part of other sills may be indicative of *in situ* development.

Mafic to intermediate metavolcanics also form a lens situated at the base of the metasedimentary sequence and overlying the felsic to intermediate metavolcanics in McCubbin and Poisson Townships. These mafic to intermediate metavolcanics include porphyritic flows, amygdaloidal flows and pyroclastic rocks.

A porphyritic, in part amygdaloidal flow bordered by metaconglomerate and felsic to intermediate metavolcanics to the north and fine-grained metasediments to the south crosses McCubbin Township just north of Kashaweogama Lake and Whimbrel Lake. Randomly oriented, subhedral to euhedral laths of porphyritic plagioclase (2 mm) are homogeneoulsy distributed in a dark green mafic to intermediate medium-grained flow. Quartz amygdules up to ¾ inch (2 cm) in diameter are locally present. The porphyritic texture and the presence of quartz suggest that this flow probably has an intermediate composition. This flow is situated immediately below the fine-grained metasedimentary sequence and is stratigraphically much higher in the metavolcanic-metasedimentary succession than the previously described nonvesicular pillow lavas. Thus, the presence of amygdules within this flow is in keeping with its relatively shallower origin of extrusion. Parts of this flow may be a crystal tuff because crystal fragments are present within the unit on several small islands in the north arm of Whimbrel Lake. This flow is about 1,500 feet (460 m) thick, but is probably composed of multiple flow units. The flow, which may be intrusive in part, is faulted off to the west and thins eastward.

A band of mafic to intermediate pyroclastic rocks is situated (Photo 6) between the metasediments and the felsic to intermediate metavolcanics in Poisson Township. The fragments are lapilli to bomb size (Fisher 1960), and range in composition from andesite to rhyolite with felsic fragments predominating. The fragments are lenticular to subrounded, and constitute about 50 percent by volume of the rock. The matrix is dark green, rich in chlorite, and highly sheared. The rock was grouped within the mafic to intermediate metavolcanics because of the mafic chloritic matrix. This band of pyroclastic rocks extends northeast to Savant Lake.

TABLE 3 | CHEMICAL ANALYSES OF ROCKS FROM McCUBBIN, POISSON AND McGILLIS TOWNSHIPS; CHEMICAL ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

Major Components in Percent

	1	2	3	4	5
SiO_2	49.10	65.60	59.60	68.70	71.20
Al_2O_3	21.00	15.90	18.70	15.00	14.40
Fe_2O_3	1.28	1.12	2.62	1.04	0.80
FeO	5.79	2.73	2.68	1.73	1.00
MgO	4.39	1.14	1.62	1.20	0.74
CaO	12.90	2.09	5.47	2.11	1.16
Na_2O	2.00	6.02	4.94	3.88	3.96
K_2O	0.14	1.69	1.06	2.24	3.62
H_2O^+	1.14	0.79	1.74	1.32	0.72
H_2O^-	0.18	0.21	0.16	0.18	0.14
CO_2	0.42	0.50	0.25	0.73	0.19
TiO_2	0.41	0.85	0.64	0.42	0.18
P_2O_5	0.04	0.16	0.18	0.10	0.06
S	0.04	0.02	0.11	0.03	0.03
MnO	0.13	0.08	0.08	0.06	0.05
Total	99.00	98.90	99.85	98.74	98.25

Trace Elements in ppm

Ag	-	-	-	-	-
Ba	80	530	350	570	570
Co	30	10	10	15	5
Cr	130	15	<10	<10	<10
Cu	70	9	35	15	6
Ga	20	15	20	20	20
Li	10	10	25	15	20
Mo	-	<10	-	<10	-
Ni	65	15	20	15	6
Pb	<10	20	65	15	35
Sc	25	-	20	-	-
Sr	100	300	600	300	200
V	180	30	80	40	20
Y	<20	25	-	-	-
Zn	60	90	70	55	45
Zr	25	190	150	120	100
Be	-	<3	<3	<3	<3
Sn	-	-	-	-	-

Notes

1 - Porphyritic "ovoid" coarse-grained flow from eastern shore of Virginia Lake. (sample B6-16a)

2 - Dacitic volcanic flow from felsic to intermediate metavolcanic sequence just north of Whimbrel Lake. (sample B8-51)

3 - Fine-to medium-grained diorite border phase of granitic stock north of Kashaweogama Lake. (sample B8-70)

4 - Quartz-rich coarse-grained trondhjemite from northern margin of granitic stock north of Kashaweogama Lake. (sample B8-73)

5 - Fine-to medium-grained (leucocratic) trondhjemite from centre of granitic stock north of Kashaweogama Lake. (sample B8-80).

Abbreviations

- Not detected

ODM9499

Photo 6–Intermediate tuff-breccia with mainly felsic fragments within a chlorite-rich matrix. From island close to western shoreline of Savant Lake in the extreme north-central part of Poisson Township.

North and east of Whimbrel Lake there is an unusual tuff-breccia. The fragments are almost all mafic to intermediate metavolcanic clasts up to 14 inches (35 cm) in size, and are situated in an andesitic tuffaceous matrix. Many of the larger fragments are rounded, but others are fractured. A few of the large fragments contain minute quartz veins which end abruptly at the contact with the matrix. The rounding of the fragments indicates that this rock may have been in part reworked.

Crystal tuff (Photo 7) was located on the northwestern side of a small island in the northeastern corner of Poisson Township immediately west of the Savant Lake Fault. The unit may be up to 250 feet (76 m) thick, but two thin (2 to 3 inches; 5 to 7 cm) silty layers within it indicate that there have probably been three separate periods of formation of crystal tuff. The silty layers are probably fine-grained tuffaceous metasediments. The crystal tuff is characterized by abundant coarse-grained, randomly oriented, euhedral to fractured laths of plagioclase (5 to 7 mm) in a green, chloritic matrix. In thin section, the plagioclase, often showing Carlsbad twinning, is moderately altered to sericite and carbonate. The matrix consists almost entirely of chlorite (penninite) with some carbonate, clinozoisite, minor biotite and epidote. Magnetite grains are regularly distributed throughout the rock. The size, frequency and fractured nature of the plagioclase laths are the main criteria used in the identification of this rock.

Volcanic conglomerate is locally present on the northern shore of the peninsula separating Southeast Bay from Savant Lake. The boulders are as much as 7 inches (18 cm) in diameter, and are composed of intermediate to felsic metavolcanics and fine-grained quartz-feldspar porphyry. A few boulders are altered

ODM9500

Photo 7–Crystal tuff from island just west of the Savant Lake Fault in northeastern Poisson Township. The densely packed crystals of feldspar have been fractured during their explosive accumulation.

around the margins, most are haphazardly arranged within an apparently tuffaceous matrix. The lateral discontinuity of this volcanic conglomerate suggests it to be a local slump feature.

A variolitic flow was noted to occur in one outcrop situated 1¼ miles (2 km) north of the eastern end of Kashaweogama Lake in McCubbin Township. The variolites average 1 to 2 mm in diameter, and are not readily apparent in the field. The extent of this flow is not known. Thin section examination shows that the variolites are highly altered to saussurite.

Cherty banded, discontinuous iron formation occurs locally within the mafic to intermediate metavolcanics.

Most commonly, the mafic to intermediate metavolcanics consist of amphibole, plagioclase, chlorite, and epidote with local concentrations of zoisite, carbonite, and magnetite. The amphibole varies from individual prismatic crystals to large radiating or tabular aggregates. Actinolite is the most common amphibole in the metavolcanics, but hornblende occurs in aureoles around felsic plutons. Plagioclase is often granular, fine grained, and exhibits little or no twinning. The plagioclase is generally altered to epidote and sericite. Chlorite is commonly present as scaly masses associated with the amphibole.

Summary Statement

The thickness and uniformity of style and composition of volcanism of the lower mafic to intermediate metavolcanic sequence, and the fact that there appears to be little or no intervening metasedimentary or metatuffaceous horizons in the metavolcanics imply that the volcanic extrusions took place continuously with few if any intervals of more explosive volcanic activity. The abundant pillow lava, and the absence of vesicles indicates that the accumulation of these early metavolcanics took place almost entirely under fairly deep water. Most of this lower sequence of mafic to intermediate metavolcanics is basaltic in composition.

The close of volcanic activity in the map-area is marked by a further cycle of mafic to intermediate metavolcanics which were extruded just before the deposition of sedimentary rocks. This mafic to intermediate metavolcanic cycle is markedly different from the earlier cycle because the volcanic rocks have substantially less volume, are more andesitic in composition, and are composed of more pyroclastic debris. Amygdules within some of the flows indicate a more shallow water origin possibly indicating the basin in which the volcanic rocks were accumulating was gradually being filled in.

FELSIC TO INTERMEDIATE METAVOLCANICS

Felsic to intermediate metavolcanics are restricted to the area north of Wiggle Creek, and Whimbrel Lake in McCubbin and Poisson Townships. This belt extends eastward towards the northwestern shore of the main part of Savant Lake. The rocks of this group are in fault contact with mafic to intermediate metavolcanics to the north and are conformably overlain to the south by minor mafic to intermediate flows and pyroclastic rocks which are, in turn, overlain by a thick metasedimentary sequence. In addition, rhyodacitic tuff-breccia occurs on two small islands located ¼ mile (0.4 km) west of the northern tip of Girard Island in the centre of Savant Lake.

At its maximum, the main belt north of Whimbrel Lake may be 11,000 feet (3300 m) wide (taken in a line extending north from the western tip of the more northerly arm of Whimbrel Lake to the junction of the trail leading off from Highway 599 at mile 20; km 32). However, because of lack of primary directional structures such as bedding, the strike of this entire succession is in doubt, hence the above estimate is speculative. Most clasts within this predominantly pyroclastic sequence are elongated N70°E which is the general trend in strike of the overlying metasedimentary sequence to the south. South-trending bedding at one exposure situated approximately 2 miles (3.2 km) south of the fault contact between the two metavolcanic groups on the western side of Highway 599 may indicate that the sequence is more complexly folded than is generally evident. Further eastward, (north of Cat Track Lodge) the unit thins to about 4,000 feet (1200 m). Moore (1928) and Rittenhouse (1936) interpreted these rocks to be part of the conglomerate sequence, and it was not until much later that Skinner (1969) designated these rocks as being chiefly felsic to intermediate pyroclastic rocks. The rock types forming the felsic metavolcanic sequence include meta-

morphosed pyroclastic rocks of all types (tuff, lapilli-tuff, and tuff-breccia; Fisher 1960), reworked tuffaceous rocks and fine- to medium-grained flows that are largely porphyritic flows. These rocks are estimated to be rhyodacitic to dacitic in composition. In mapping, where possible, these rocks were subdivided on the basis of colour index (see section on "Early Precambrian metavolcanics") into dacitic to andesitic metavolcanics (map unit 2b, Map 2357, back pocket) and rhyodacitic to rhyolitic metavolcanics (map unit 2a, Map 2357, back pocket). A chemical analysis of a typical flow unit which is located just above the west end of Whimbrel Lake and approximately 2,000 feet (600 m) east of Highway 599 is given in Table 3, analysis 2 and shows it to be dacitic in composition. Pyroclastic rocks constitute at least 85 percent of the total volume of the formation.

The felsic to intermediate metavolcanics invariably have dark grey fresh surfaces and weather white to pink.

The pyroclastic rocks are heterogeneous in size, texture, and composition. Individual fragments range in size from ash to coarse bombs up to 3 feet (0.9 m) long. The variation in composition of the fragments from mafic to felsic is reflected by lateral, vertical and chaotic changes over tens of feet. Because of the rapid variation and heterogeneous character of the felsic to intermediate metavolcanics correlation of small scale units was generally not possible. The majority of the fragments are stretched and lensoid in form, especially the intermediate to mafic clasts. Many of the felsic fragments are subrounded, and are not highly stretched. Mafic to intermediate fragments are not common, weather lower than the matrix and in most cases form a conspicuous pitted appearance. On the other hand, the more voluminous felsic to intermediate fragments are often difficult to distinguish from the matrix because of their similarity in composition to the matrix. Silicification, especially on the northern shore of Whimbrel Lake, is present in the form of silica-rich stringers which, in places, coalesce to form veins.

Approximately ¾ mile (1.2 km) south of the north-northeast trending fault on Highway 599, there is a polymictic tuff-breccia which resembles the polymictic orthoconglomerate (map unit 3a) in northwestern McGillis Township. The unit is up to 700 feet (210 m) thick and is traceable for ¾ mile (1.2 km). This tuff-breccia contains fine-grained, felsic porphyritic fragments, mafic to intermediate metavolcanic fragments and subvolcanic fragments.

The outcrop of this rock located on the west side of Highway 599 exhibits vague, discontinuous bedding locally striking transverse to the elongation of the fragments. The matrix is grey to green and is siliceous. The more mafic fragments tend to blend into the matrix. In the western extension of this breccia unit, the felsic fragments are larger in size and become more numerous whereas the number of mafic fragments decreases.

Northward from the above heterolithologic tuff-breccia on Highway 599, a homogeneous rhyodacitic agglomerate occurs characterized by felsic bombs up to 3 feet (0.9 m) in a matrix of similar composition. Locally, it is bedded as seen in the exposure 1,500 feet (460 m) north of the polymictic tuff-breccia (codes 2e,b, 3a, Map 2357, back pocket) on the west side of Highway 599. Some of the bedding may represent an ash fall, or may be the result of reworking. The bedding, trending at N10°E, strikes at a high angle to the regional foliation. The beds seem to grade in both directions and it was not possible to obtain a facing direction. This may be just a local slump feature, however, both these previously mentioned bedded units, although discontinuous, trend north-south and this

may in fact be the true trend of the felsic-intermediate metavolcanics in this part of the area.

To the east, towards Savant Lake, the pyroclastic rocks become more intermediate in composition and the breccia fragments are slightly smaller. An unusual lapilli-tuff unit was mapped just south of the granitoid boulder-bearing conglomerate located on the island in northeastern Poisson Township. The unit is 400 feet (120 m) wide and consists of sparsely distributed (5 percent by volume) felsic (in part cherty) metavolcanic pebble size fragments (averaging 3 to 6 cm) in a tuffaceous-looking matrix (no thin sections of either the fragments or the matrix were cut).

Porphyritic felsic flows are common east of Highway 599 in the southern part of the exposure of the felsic to intermediate metavolcanics. The flows are characteristically charged with minute, sparsely distributed, randomly oriented plagioclase laths averaging ⅛ inch (3.2 mm) long. Other than the feldspar laths, which are nearly always present, these rocks are relatively featureless. Flow contacts were not seen, but multiple flow units are probably present. North of Whimbrel Lake, the felsic metavolcanics are probably tuffs or flows; they are completely devoid of diagnostic textures, and thin section examination shows them to be highly recrystallized, and composed of granular quartz and feldspar.

The felsic to intermediate metavolcanics in general consist in thin section of a fine-grained, recrystallized groundmass of plagioclase (albite-oligoclase) and quartz. Biotite and chlorite are also present, and constitute from 10 to 30 percent of the rock. The biotite, forming minute, bent plates is far more common than the chlorite which tends to form locally in clots. The prevalence of biotite is related to the nearby granitic intrusive body in northwest Poisson Township. Granular epidote and carbonate are often present as alteration products. Sphene and magnetite are minor accessories. The flows are similar to the above, except that two size fractions of euhedral plagioclase phenocrysts are apparent in thin section. The megascopic laths of plagioclase (An_{10} to An_{12}) are twinned after the albite and pericline laws and locally form clusters. In addition to these small phenocrysts, there are, within the matrix, microlites of euhedral plagioclase averaging 0.2 mm in length. The microlites are generally more extensively altered than the coarse laths and the twinning is poorly developed. The microlites exhibit subalignment in some thin sections and in some, this alignment is deflected around the megascopic plagioclase phenocrysts. This may represent relict pilotaxitic flow texture.

Two islands situated west of Girard Island consist of rhyodacitic to rhyolitic tuff-breccia. The fragments within the tuff-breccia are extremely hard to distinguish from the matrix because of their similarity in composition, but are more readily visible under water. The fragments weather slightly lighter coloured and higher than the matrix. The matrix is somewhat pitted. Weathering has imparted a creamy yellow-green colour to the exposed surface with local pink and light green coloured patches. The fragments are rounded to subangular, range in size from 2.5 cm to 0.5 m, and average 12 cm, and have very poorly developed border zones. A few of the fragments contain plagioclase phenocrysts. Many of the fragments exhibit lighter weathering, ¼ inch (6.3 mm) thick, border zones. The border zones, which only circumscribe part of the fragments, may represent original quenched surfaces on bombs that have been fragmented either on impact with the ground or against one another.

Several minor quartz-carbonate zones that are moderately sheared occur as thin layers, 100 feet (30 m) wide, within the mafic pillow lavas on several islands in the extreme north part of McGillis Township. These may represent original tuffaceous horizons.

Metasediments

The western part of Poisson Township and the southern half of McCubbin Township are largely underlain by metasediments west from Savant Lake. The metasediments are in fault contact with mafic to intermediate metavolcanic rocks to the north and to the east, but are concordant with, and interlayered with the metavolcanics north of Kashaweogama and Whimbrel Lakes.

As indicated in Table 2, Timiskaming-type metasediments and associated metavolcanics were formerly classified under the heading Savant Group by Moore (1928) who used the term to include "all rocks older than the granitic intrusions". Rittenhouse (1936) subdivided Moore's Savant Group and applied the name "Savant Series" only to the metasediments designating the associated metavolcanics, the "Handy Lake Volcanics". Skinner (1969) revised the classification, incorporating the Timiskaming (?) metasediments and the Handy Lake volcanics under Moore's (1928) original Savant Group classification.

In the field, the metasediments were subdivided by the present author into three mappable formations: (1) conglomeratic metasediments, (2) ferruginous metasediments, and (3) arenaceous metasediments.

Conglomeratic metasediments occur locally at the basal section of the metasedimentary sequence. In McCubbin Township, the conglomerate is in fault contact with the mafic to intermediate metavolcanics to the north. To the east, the large basin of ferruginous and arenaceous metasediments appears to consist of lateral facies equivalents of the metaconglomerate. Further east in northeastern Poisson Township and northwestern McCubbin Township, metaconglomerate appears to overlie the mafic to intermediate metavolcanic sequence. The ferruginous and arenaceous metasediments differ only in that quartz-magnetite iron formation occurs intimately interbedded with arenaceous beds in those exposures designated as ferruginous metasediments.

CONGLOMERATIC METASEDIMENTS

Metaconglomerate has long been recognized as perhaps the most distinctive unit in the map-area. The first mapping by Moore (1928) outlined the unit fairly accurately. However, the metaconglomerate is not nearly as thick or as extensive as Rittenhouse (1936) envisaged because much of the area mapped by him as metaconglomerate is actually pyroclastic in origin. Metaconglomerate is restricted to a band north of Kashaweogama Lake and to several islands in Savant Lake in the northeastern part of Poisson Township and northwestern McGillis Township. The metamorphosed conglomerate was subdivided into two main types by the author on the basis of texture and on the composition of the clasts

ODM9501

Photo 8- Polymictic orthoconglomerate from exposure northeast of Kashaweogama Lake approximately 3,500 feet (1050 m) northwest of the sharp right hand bend in Highway 599. Note the secondary quartz cutting across the granitic boulder in the centre of the photograph. Ruler is approximately 6 inches (15 cm) long.

contained within it: (1) polymictic orthoconglomerate (granitoid clasts) - map unit 3b (Map 2357, back pocket); (2) polymictic orthoconglomerate (metavolcanic clasts) - map unit 3a (Map 2357, back pocket).

The polymictic orthoconglomerate (unit 3b; Photo 8) with granitic clasts forms a unit north of Kashaweogama Lake, and is also found on one of the islands in northeastern Poisson Township. At its widest, north of Wiggle Creek, the granitoid boulder-bearing metaconglomerate band is 2,500 feet (720 m) wide. In the west of the map-area the metaconglomerate band thins to an average width of about 1,000 feet (300 m). This metaconglomerate is distinguished by the presence of granitoid boulders. Besides the granitoid clasts, which constitute up to 50 percent of the clasts, this metaconglomerate contains mafic to intermediate metavolcanic, felsic to intermediate metavolcanic, dioritic, minor chert and a very few iron formation boulders, cobbles and pebbles. The percentage of matrix varies from 20 to 25 percent, and the clast framework is generally intact.

Typical granitoid clasts are medium- to coarse-grained porphyritic trondhjemite, a few are fine to medium grained, and are composed of megascopic patches of quartz, plagioclase and less abundant ferromagnesian minerals; the patches range in size from 3 cm up to 66 cm. Generally, the trondhjemitic fragments are well rounded and have hardly been elongated by the regional defor-

mation. Funk (1973) found that some of the granitoid clasts in this metaconglomerate have a granodioritic composition. Towards the base of the metaconglomerate in McCubbin Township granitoid clasts apparently become more abundant compared to the amount of volcanic clasts. Also coarser grained granitoid clasts are most abundant in the eastern part of the unit, whereas fine- to medium-grained granitoid clasts are more abundant south of Heron Lake in the west.

A thin section study of a granitoid boulder showed the plagioclase to be albite-oligoclase. Plagioclase forms subhedral crystals up to 5 mm in length that are moderately altered to shredded sericite and minor epidote. Some of these plagioclase crystals appear to be in glomeroporphyritic aggregates; many are fractured. There are also smaller (1 mm) anhedral plagioclase crystals institial to the larger plagioclase crystals, and these smaller feldspar crystals are free of any sericitic alteration, and exhibit a patchy texture that may be antiperthite. Quartz is anhedral to euhedral and is fractured but not recrystallized. Anomalously blue birefringent chlorite and muscovite form interlocking masses with, and nearly completely replace biotite. Zircon crystals are commonly associated with these mafic masses, and are oriented parallel to the cleavage trend of the interlocking mafic minerals. A modal analysis of a typical trondhjemitic boulder is given in Table 3, number 2. Funk (1973) found the average granitoid clast to be composed of 32.9 percent quartz and 55.6 percent plagioclase. The author visually estimated the quartz content in some of the clasts to be up to 45 to 50 percent, and one of the modal analyses by Funk indicated one of the granitic clasts to contain 48.8 percent quartz. A search of the literature by the author disclosed the fact that most trondhjemitic to granodioritic plutonic rocks contain less than 35 percent quartz.

The presence of granitoid clasts in Archean conglomerates has long been thought to be evidence of an early granitic terrain.

According to Hughes and Bruckner (1971, p.902)

> Coarse grain size in granites is not necessarily a criterion of crystallization at great depth, but is in a volcanic association, indicative merely of crystallization under conditions where magmatic water did not readily escape from the magma chamber during cooling.

This retained water would tend to lower the temperature and prolong the period of crystallization (Hughes and Bruckner 1971). The anomalously high quartz content present in some of the granitoid clasts of the conglomerate suggests that the clasts probably originated from a granitic mass in which quartz-rich rock crystallized in water-rich magma pockets (Hughes 1971). Thus, the granitoid clasts may have been derived from a high level intrusive. The presence of subhedral to euhedral quartz has been noted in several subvolcanic intrusives, including the Rocky Hill epizonal granodiorite pluton described by Putman and Alfors (1969). The euhedral form would be expected if the crystallization proceeded slowly, and the temperatures were low enough to allow the quartz to grow freely without being impinged upon by other crystallizing minerals. Most probably, as Funk (1973) also concluded, the granitoid boulders were derived from a local small, epizonal intrusive body.

Mafic to intermediate metavolcanic fragments constitute about 15 to 20 percent of the total clasts; they are green, often difficult to distinguish from, and weather lower than the matrix. Least competent of all the types of clasts, these

ODM9502

Photo 9–Polymictic orthoconglomerate characterized by mainly metavolcanic clasts. From island in Savant Lake, northwestern McGillis Township.

clasts are generally highly stretched and envelop the more competent felsic extrusive and intrusive clasts. Felsic to intermediate clasts compose 20 to 25 percent of the total population. The clasts are not as highly stretched as the more mafic fraction and weather higher than the matrix. One flow-banded rhyolitic fragment was noted to occur in the exposure 3,500 feet (1100 m) northwest of the sharp righthand bend in Highway 599. Dioritic and cherty clasts account for the remainder of the fragments. One iron formation boulder was seen on an island exposure of the granitoid boulder-bearing polymictic orthoconglomerate in northeastern Poisson Township.

The granitoid clasts in the orthoconglomerate are indistinct towards the contact with the Heron Lake Stock because of their similarity to the matrix. The matrix weathers buff-brown, has a grain size of 2 to 3 mm, and contains up to 40 percent slightly deformed quartz grains. The matrix becomes more chaotic to the south, and the clasts are more distinct than to the north. Thin section examination reveals that the matrix is a greywacke with subangular grains of quartz, 2 to 3 mm in size.

The polymictic orthoconglomerate (Photo 9) with metavolcanic clasts, map unit 3a, is similar to the polymictic orthoconglomerate with granitoid clasts (map unit 3b, Map 2357, back pocket) except that it lacks granitoid clasts. This volcanic orthoconglomerate is composed of much less matrix material (5 percent maximum) than the previously mentioned polymictic orthoconglomerate with

granitoid clasts, and has more of a pyroclastic, breccia-like texture. Eighty percent of the clasts are mainly of volcanic origin, and are composed of mafic and felsic metavolcanics in equal proportions; the remaining 20 percent are formed of partly porphyritic dioritic and gabbroic rocks. About 2 to 3 percent of the clasts appear to be chert. The clasts within this orthoconglomerate (map unit 3a, Map 2357, back pocket) are generally slightly smaller than the polymictic orthoconglomerate with granitoid clasts (map unit 3b) ranging from 3 cm to 20 cm and averaging 10 to 15 cm on the outcrop surface. Metaconglomerate composed mainly of volcanically derived clasts is exposed on several islands in Savant Lake in northwestern McGillis Township and appears to be as much as 5,000 feet (1500 m) thick. The metaconglomerate appears to be faulted off to the northeast (?). Possible, large-scale conglomerate bedding striking at S70°E was observed on the northern tip of one of the island exposures. This trend is transverse to the foliation developed within this metaconglomerate. No iron formation clasts were noted in this metaconglomerate. The author visited the Sturgeon Lake area to the south and polymictic orthoconglomerate unit 3a (Map 2357, back pocket) is very similar in texture and composition of clasts to the volcaniclastic conglomerate-breccia units (Trowell 1974, map unit 2h) exposed on the islands in the Northeast Arm of Sturgeon Lake.

The relationship of the two polymictic orthoconglomerate units is not apparent in the map-area because of their wide separation. The fact that the polymictic orthoconglomerate with volcanic clasts does not appear to be associated with the polymictic orthoconglomerate with granitoid clasts exposed in McCubbin Township suggests that the former is only a local deposit of perhaps smaller magnitude.

FERRUGINOUS AND ARENACEOUS METASEDIMENTS

The finer grained metasediments were subdivided in the field into two broad categories based upon the presence or absence of interbedded iron formation. In the legend, these are designated as "ferruginous metasediments" and "arenaceous metasediments" respectively. The two types form easily mappable units based on the presence or absence of iron formation, but generally, were it not for the presence of the iron formation, the two appear very similar in texture and composition and would not be distinguishable. The presence of iron formation in the area was first noted about the turn of the century, and was documented by Moore (1910) soon after. However, it was not until Rittenhouse (1936) mapped the area that the iron-bearing metasediments were delineated with any accuracy. Rittenhouse (1936) conceived that the iron-bearing metasediments occupied two separate bands, but field mapping during the present geological survey disclosed that the two bands are in fact joined as one continuous belt, and have been complexly folded.

The ferruginous and arenaceous metasediments are stratigraphically situated in part above, and in part as a possible lateral facies transition of the polymictic orthoconglomerates. In surface plan, the main ferruginous formation re-

sembles an incompletely closed triangle. The ferruginous metasediments appear to be concentrated in part, at the base of the metasedimentary sequence, and are overlain by the arenaceous metasedimentary sequence. This relation is valid along the north arm of the ferruginous metasedimentary sequence. To the south, however, in the vicinity of Snowbird Lake, the lateral extension of these same ferruginous metasediments appears to be underlain by a sequence of arenaceous metasediments, and facies transition could perhaps account for this. Because of the overall complex folding that is evident in these rocks, a true cross-sectional thickness is difficult to measure. The ferruginous metasediments are widest at the nose of the fold on the western shore of Savant Lake in Poisson Township. In this location, the exposed metasedimentary sequence is between 8,000 and 11,000 feet (2400 to 3350 m) wide. Westward, away from the nose of the fold, the two ferruginous metasedimentary limbs of the fold get progressively thinner, down to about 2,000 feet (610 m) until they disappear between Highway 599 and Kashaweogama Lake. Their abrupt termination may be caused by faulting, facies change, or isoclinal folding; the first appears to be the most plausible to the author. Ferruginous metasediments also form an isoclinal synclinal fold in the extreme southwestern corner of McCubbin Township.

Arenaceous, non iron-bearing metasediments occupy the interior of the triangle shape formed by the ferruginous metasediments. Arenaceous metasediments also occupy the area between the main ferruginous metasedimentary belt and a tightly folded band of ferruginous metasediments in the extreme southwestern corner of McCubbin Township. Exposure in the southwestern corner of McCubbin Township is very poor, but the arenaceous and ferruginous metasediments in this part of the map-area also appear to be concordant with one another. It is not known by the author whether these ferruginous metasediments in the extreme southwestern corner of McCubbin Township are stratigraphically equivalent to the main ferruginous metasedimentary sequence to the northeast, and have acquired their present configuration during folding, or whether they were formed at a different stratigraphic level.

The metasediments are composed, in order of abundance, of interbedded greywacke, subgreywacke to sandstone, siltstone, chert-magnetite iron formation, siliceous siltstone (in part tuffaceous and cherty) and minor jasper iron formation. Within the ferruginous metasediments, greywacke, subgreywacke and sandstone were not separated in the field, and were grouped together under map unit 4a. All of the metasediments are metamorphosed and the prefix "meta" is implied in all subsequent descriptions. Greywacke averages about 60 to 65 percent of the exposure, siltstone about 20 to 25 percent and iron formation about 10 to 15 percent. There are numerous exceptions to the above estimates, and iron formation, for example, is locally found to make up 75 percent of some of the exposures.

Outcrops are generally low and flat with little preferential erosion although, in most locations, the iron formation shows a slight tendency to be more resistant and weathers higher than the remainder of the rock. Exposures are best seen along the lake shores. Areas of good exposure are generally separated by large areas of extremely poor exposure.

Commonly, all the metasedimentary types listed above are intimately interbedded with one another, but in places, a single type is found to dominate, and forms discrete mappable units. For example: (1) the metasediments in the vicin-

ity of the eastern part of Kashaweogama Lake are predominantly finely bedded to laminated siltstones; (2) the metasediments south of the iron-bearing metasediments in the vicinity of Snowbird Lake are very fine grained, reworked felsic tuffaceous siltstones; (3) much of the metasedimentary rock along the western shore of Savant Lake is subgreywacke to sandstone and iron formation; and (4) much of the arenaceous metasediment in the centre of the major fold structure is composed typically of graded greywacke siltstone beds.

The following sequences of types of metasediments are widespread:

(1) Massive to graded greywacke grading up into siltstone and sharply overlain by iron formation (see Photo 12);

(2) Massive to graded greywacke sharply interbedded with iron formation (see Photo 13).

Only two cases were observed where greywacke graded up through siltstone into iron formation. Normally, the upper and lower boundary of the iron formation bands were extremely sharp.

A large part of the greywacke associated with the iron-bearing metasediments is magnetic to varying degrees, and the presence of dissiminated angular magnetite throughout is confirmed by thin section study. Magnetic greywacke weathers grey-purple to buff-brown and has a dark grey, fresh surface. Nonmagnetic greywacke weathers grey to buff-brown to greenish and on the fresh surface is light to dark grey-green. Siltstone weathers from light brown to most commonly light green and is grey-green on fresh surfaces. Felsic tuffaceous metasediments are fine-grained, weather grey-white, and are thinly bedded, ½ to 1 inch (1.3 to 2.5 cm) thick. Iron formation is typically purple on the weathered surface and is generally dark grey-black on the fresh surface.

The metasediments, as a group, have undergone only very low grade metamorphism as indicated by mineral assemblages and preservation of abundant primary structures. The mineral assemblages mainly encountered in thin section are albite + quartz ± muscovite ± chlorite ± biotite ± epidote, and are indicative of lower greenschist facies metamorphic rank.

Primary textures and structures are generally well preserved. Bedding is very regular, and well preserved throughout. Individual beds are laterally continuous over several hundred feet. They are traceable across single outcrops, but generally cannot be extended further because of lack of exposure; beds were only rarely observed to pinch out along strike. The bedding of the coarser (greywacke) fraction ranges from ½ inch to 20 feet (1.2 cm to 6 m) and averages 3 to 6 inches (7.6 to 15 cm) thick. Some of the thicker beds may be composed of multiple beds. Silt-size metasediments are characteristically thinly laminated (minimum of 1 mm thick) to thinly bedded (up to a maximum of 3 cm) but averaging ⅛ to ¼ inch (3.1 to 6.3 mm) thick. Generally, the beds are composed of several laminae.

Graded bedding is present in about 20 percent of the beds, but is not evident in most areas because of lichen cover. In the field, grain gradation is rendered more conspicuous by the presence of one or more of the following:

(1) The lower margin of individual beds (whether graded or massive) is abrupt while the contact between the coarse fraction and the overlying finer fractions is indistinct.

(2) There is generally a gradual darkening of colour concomitant with decrease in grain size.

(3) The finer silty fraction appears to weather slightly lower relative to the coarse fraction, and in cross-section a graded bed appears to grade upward uniformly towards the finer silty fraction.
(4) In some places, lichen appears to attach more readily to the coarser fraction, possibly because of the higher relief and rougher surface.
(5) Fracture cleavage, where developed, is more closely spaced in the finer fractions than in the coarser fractions; locally beds show refraction of cleavage.

Generally, the more thinly bedded greywacke beds show evidence of grain gradation, while the thicker beds show almost none.

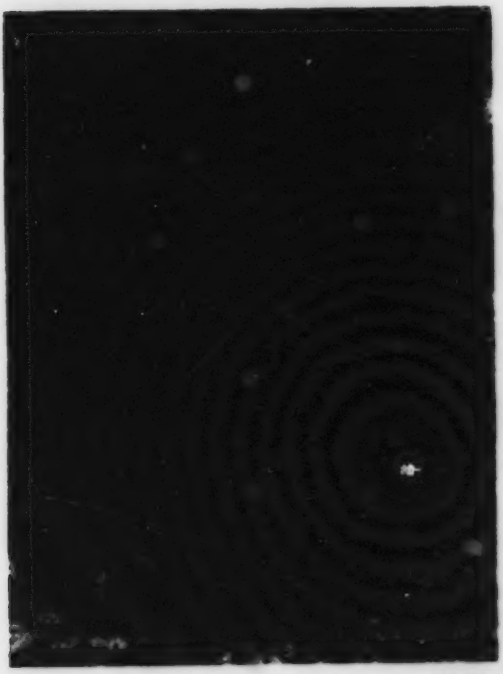
Locally, other primary structures (many of which may be used as top determinations) are also well preserved and these include flame structures, ripple-drift cross-laminations, cut and fill structures, and sand dikes (Photo 10). A few chert and mudstone fragments are found included in coarser subgreywacke to sandstone beds (Photo 11).

The coarser fraction of the arenaceous metasediments is composed mostly of greywacke and sandstone, and is most prevalent in the area along the western shore of Savant Lake near the base of the metasedimentary sequence. Thin section examination reveals that quartz and plagioclase are bimodally distributed forming coarse grains supported in a granular, finer grained matrix. Quartz is generally the coarser component, is as much as 4 mm in size, and is readily visible in hand specimen. The large quartz grains are subrounded to angular, and texturally the coarse-grained metasediments are immature. The large quartz grains are the least recrystallized, and where compound and polygonized are generally composed of only a few segments. This polygonization is commonly confined to the margins of the grains, and is probably caused by later tectonic deformation. Plagioclase is also present forming coarse grains and is in places, more abundant than the quartz. Plagioclase is recrystallized and generally untwinned, although albite twinning is locally observed in thin section. The margins of the subhedral to anhedral grains of plagioclase are commonly granulated. Rock fragments are occasionally present, but are rarely distinguishable from the matrix. The above mentioned coarse components vary considerably in size, grading from a maximum diameter of 4 to 5 mm down to the size of the matrix, but the majority are greater than 0.2 mm in diameter.

The matrix grains are poorly defined, and consist of a matted mixture predominantly composed of feldspar, quartz, micaceous minerals (muscovite, biotite, chlorite) and carbonate material. Metasedimentary beds believed to be quite massive in the field were found to be moderately well foliated in thin section with the foliation running parallel to the bedding strike.

Abundant chlorite was observed in several of the thin sections of siltstone, and is the cause of their green colouration.

The siliceous siltstones that are interbedded with subgreywake to sandstone southwest of Snowbird Lake have a very low mafic content ($\leqslant$5 percent), and appear similar to, and have probably been derived from the felsic to intermediate metavolcanic sequence to the south in northeastern Conant Township (Bond 1973a). These siliceous siltstones are also found along the western shore of Savant Lake, but are much less abundant. They are very fine grained ($\leqslant$0.1 mm) and equigranular in thin section.



ODM9503

Photo 10–Sand dike disrupting overlying iron formation and greywacke beds. From west shore of Savant Lake.

ODM9504

Photo 11–Chert inclusions eroded from underlying bed and incorporated in overlying turbidite, from west shore of Savant Lake.

METAMORPHOSED IRON FORMATION

Metamorphosed iron formation is associated with two rock units in the map-area. While present in only minor abundance in the mafic to intermediate metavolcanics, it is extensively developed in the ferruginous metasedimentary belt. The percentage of iron formation to greywacke and siltstone appears to vary randomly throughout the ferruginous metasediments. Nevertheless, the areas of highest iron formation concentration are reasonably well defined by the highs on the regional Aeromagnetic Maps (ODM-GSC 1961a,b) and occur along the west-central shore of Savant Lake, and near the southwestern corner of McCubbin Township, south of Kashaweogama Lake. The iron formation is present in sufficient quantities that compasses were found to be unreliable in most of McCubbin and Poisson Townships, and caused a 12 degree deflection as far away as the eastern shore of Savant Lake.

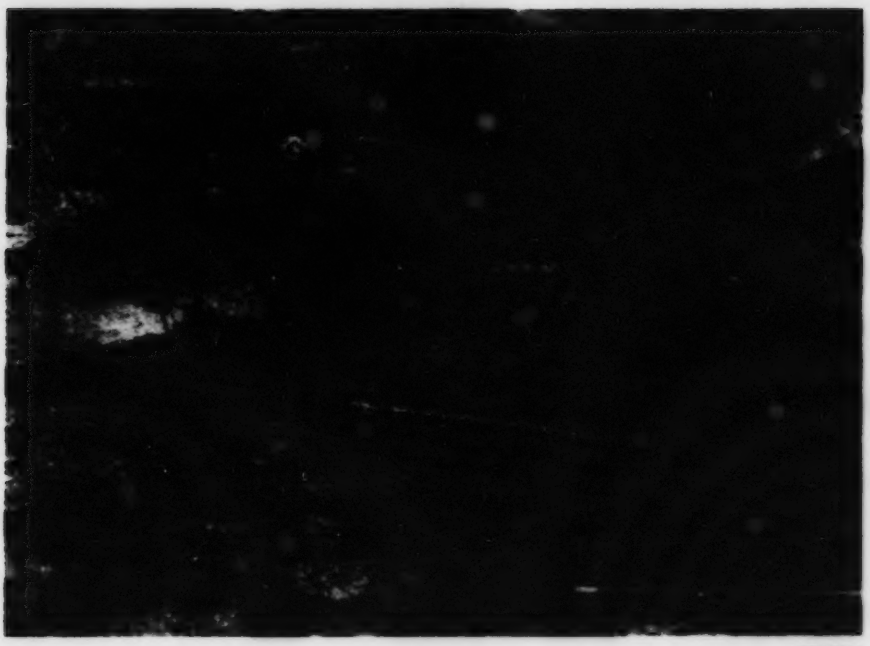
The iron formation, although intimately related with the arenaceous part of the ferruginous metasediments, forms discrete beds characterized by sharp contacts on both the upper and lower surfaces of individual beds. Continuous gradations from greywacke to siltstone to iron formation is very rarely developed.

The iron formation is typical of Algoma-type oxide facies (Gross 1965) found elsewhere in the Superior Province, consisting of thinly laminated layers of metachert that alternate with magnetite layers. The amount of iron formation at any single exposure is dependent upon two factors:

(1) The number and width of the sedimentary beds present.
(2) The percentage of magnetite to chert in the internal laminations within individual beds.

A very general relation between the width of the iron formation band and the thickness of the bedding in the arenaceous metasedimentary host was noticed during the field mapping. Generally, thicker bands of iron formation were found associated with the thicker, more massive greywacke-sandstone beds. Where the iron formation is interbedded with finer grained silty metasediments, the chert-magnetite beds form a smaller percentage of the total volume, and are more thinly bedded. Typically, the iron formation forms beds or layers regularly deposited between individual arenaceous sedimentary beds (Photo 12).

Iron formation beds vary in thickness from 0.06 inch (1.6 mm) to 15 feet (4.6 m), and average 1.3 to 5 cm. Laminations of metachert within the iron formation bands range in thickness from 0.05 to 2 mm (Photo 13) and are irregularly spaced. Jasper occurs locally interbedded with the magnetite layers on the western shore of One Pine Lake. Specular hematite was noted in several parts of the ferruginous metasediments, but the exact percentage in relation to the magnetite is not known. Thin and thick beds are continuous over single exposures, and if distinctive enough can be traced out across several outcrops. One 3-foot (0.9 m) thick bed situated approximately 750 feet (230 m) west of the western shore of Savant Lake and 4,000 feet (1,200 m) northeast of One Pine Lake in central Poisson Township is indicated by code 4d on Map 2357 (back pocket) and was traced out for 700 feet (200 m). Compared to all rock units in the area the iron formation behaved least competently during preconsolidation and tectonic deformation. Contorted bedding, flame structures (Photo 14), minute, haphazard ripple contortions are present, the result of preconsolidation deformation. Local-



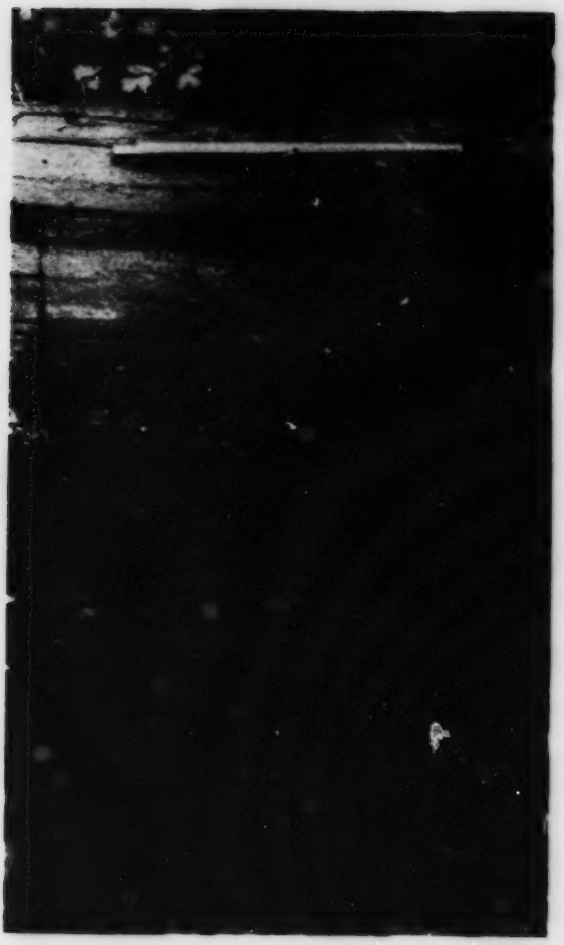
ODM9505

Photo 12–Typical ferruginous metasediments with regularly deposited greywacke grading up into siltstone and capped by iron formation. Note minute cross faults. From west shore of Savant Lake near the nose of the major synformal fold exhibited by the ferruginous metasediments.

ly, the iron formation behaved competently; in one exposure southeast of One Pine Lake an iron formation bed 3 mm thick, was overlain but not disrupted by a massive greywacke bed, 1.3 m thick.

It is apparent in thin section that the iron formation is recrystallized, and consists of magnetite, interlayered with quartz laminae. Magnetite is by far the most common opaque mineral; it forms subhedral to anhedral grains, is concentrated into loosely packed laminae, and occurs also as disseminations within the associated arenaceous metasediments. In the field, much of the greywacke is moderately to strongly magnetic. The metachert layers are composed of granular recrystallized quartz, sparsely distributed magnetite crystals and minor, probably secondary, carbonate. The carbonate occurs as disseminations (approximately 5 percent) that are locally vaguely concentrated into thin discontinuous pods. Plagioclase (albite-oligoclase) is also found associated with the metachert layers.

The iron formation within the mafic to intermediate metavolcanics forms small discontinuous bands that average about 5 to 10 feet (1.5 to 3 m) thick, and also consists of interbedded metachert and magnetite layers.



ODM9506

Photo 13–Broken beds of iron formation and interbedded subgreywacke/sandstone from the west-central shore of Savant Lake near the nose of the major synformal fold exhibited by the ferruginous metasediments.

DEPOSITIONAL ENVIRONMENT

Although, in general the metasediments of Savant Lake appear to be similar to other Early Precambrian metasediments described by Ojakangas (1972) and Henderson (1972), they differ sharply from them because of the presence of the iron formation.

ODM9507

Photo 14–Flame structures in iron formation from west shore of Savant Lake near nose of fold. Note the scour laminations of the overlying greywacke bed as well as the ripped-off tips of the flames.

The primary structures present leave little doubt that the arenaceous part of the metasediments has been deposited by turbidity currents. Complete turbidite sequences of internal structures described by Walker (1967) are rare in the map-area but do exist. Most commonly, as in the metasediments of the Burwash Formation at Yellowknife, Northwest Territories, described by Henderson (1972), only the lower graded division and the upper division of parallel lamination (Walker 1965) are found. Based upon criteria outlined by Walker (1967), sedimentary structures in the arenaceous component of the ferruginous metasediments indicate that these vary from proximal to distal facies deposits. The thick, massive, non-graded greywacke-sandstone beds with little or no interbedded siltstone common near the base of the succession, such as those along the western shore of Savant Lake, imply proximal derivation. The greywacke-siltstone sequences are more thinly bedded and their internal structures infer that these are more distal having been deposited well below wave base. At Kashaweogama Lake, the metasediments are laminated to thinly bedded siltstones and possibly represent more distal facies. Sand dikes, locally present near the base of the sequence, range in size from 8 cm (3 inches) up to 1 m (3 feet) and indicate that the turbidites were being deposited in rapid succession trapping pockets of air or water which, with increasing compaction, exploded upwards.

The granitoid clast-bearing conglomerate north of Kashaweogama Lake probably represents proximal facies derived from a local source. Finely bedded siltstones with minute, delicate ripple cross-laminations on the northeastern shore of Kashaweogama Lake indicate reworking by slowly oscillating currents under quiet conditions and perhaps represent distal facies. These siltstones,

which in places form uninterrupted sequences up to 600 feet (180 m) thick, may have been derived from a distal source, unrelated to the source of the conglomerates,but related to the same source as the proximal greywacke facies to the east. Southwest of Snowbird Lake, the abundant siliceous, tuffaceous metasediments indicate a more felsic source was involved in the formation of these rocks.

Mapping south of this area, Bond (1973a) indicated that a thick metavolcanic sequence to the south, largely felsic to intermediate in composition, faces north. The siliceous metasediments southwest of Snowbird Lake are very similar in composition to the felsic to intermediate metavolcanics found east of the granitic stock at Grebe Lake in Conant Township outside the map-area (Bond 1973a). Thus, these metasediments appear to be deposited on top of this felsic to intermediate metavolcanic sequence. The abundant quartz clasts found in much of the metasedimentary greywackes also suggests a source composed of felsic to intermediate rocks. The restriction of proximally deposited sandstone units to the lower part of the metasedimentary sequence exposed along the western shore of Savant Lake is to be expected.

The intimate association of the iron formation with the individual turbidites is convincing evidence that the iron formation was deposited below wave base. The sharp boundaries above and below each bed of iron formation, and the lithological contrast of the iron formation beds with the arenaceous beds seems to indicate that two contrasting sedimentary processes were active at the same time in the Savant Lake area during formation of the ferruginous metasedimentary sequence. The sharp boundaries above and below the iron formation beds suggest that the iron deposition was chemical, and entirely unrelated to the clastic deposition of the turbidites. Chemical deposition of the iron formation appears to have been a continuous process throughout the early depositional history of the arenaceous metasediments but it was interrupted frequently by turbidite deposition. Rapid influx of clastic turbidite material periodically interrupted the quiet accumulation of the iron formation. The magnetite grains within the individual turbidites may have been caught up by the coarser, higher energy part of the turbidite, and were deposited rapidly with the greywacke material. However, these magnetite grains within the coarser turbidites may also be authigenic, having been precipitated out of small water pockets contained within the rapidly deposited turbidites. Pre-lithification slump folds in the iron formation, bordered by undeformed arenaceous beds, indicate that the iron formation must have been at least in part in a very plastic state for some interval of time after its deposition, and that some degree of slope existed at the site of deposition, for example the flanks of a volcanic centre.

The absence of iron formation and disseminated magnetite grains in the arenaceous metasediment formation may have been caused by an increased rate of clastic sedimentation or by the cessation of iron forming conditions probably related to waning volcanism.

Mafic Intrusive Rocks

The rocks classified as Mafic Intrusive Rocks are restricted to small sills of metagabbro and metadiorite in the mafic to intermediate metavolcanics and to one, fairly extensive metagabbro sill within the metasediments. The porphyritic

gabbro sill mapped as mafic metavolcanics near Elga Lake may also have been intruded at this time.

The mafic sill in the metasediments in southern McCubbin Township is probably 400 to 500 feet (120 to 150 m) thick. No evidence exists to indicate that the sill is intrusive, or that it is composed of multiple phases of lava, but it appears to be too thick to be a single flow. The sill can be traced discontinuously in the map-area for about 2 miles (3.2 km). On the northern shore of Kashaweogama Lake a gabbroic sill is highly sheared and pitted because of the intersection of shearing and cleavage. This sill may be a continuation of the one described above. The metagabbro sill is massive, dark green, medium to coarse grained, and is amphibolitized especially near the Heron Lake Granitic Stock. The sill consists of 40 to 60 percent mafic minerals (actinolite-hornblende), 40 to 50 percent saussuritized plagioclase which is granulated in part, and minor amounts of chlorite and epidote.

Several isolated occurrences of metagabbro to metadiorite occur in the mafic to intermediate metavolcanics in the vicinity of Pride Lake in McGillis Township. Generally these rocks occur as sills that are traceable for only short distances (500 to 1,000 feet; 150 to 300 m); exhibit a wide variation in texture and colour, and are medium to coarse grained. In the field the rocks are white, evenly spotted with a dark green, heavily saussuritized laths of plagioclase (5 mm). The light-coloured groundmass is composed mainly of colourless tremolite with minor amounts of chlorite and epidote. Quartz occurs locally in thin sections; is granulated and may be secondary in origin. Locally, the rocks exhibit a mottled texture in the field with both plagioclase and actinolite forming irregular patches. No conclusive evidence was found in the field to indicate that these rocks are intrusive. Trowell (1972) found rocks of similar composition and texture to be intrusive into felsic to intermediate metavolcanics in the Sturgeon Lake area. The metagabbro-metadiorite sills in the map-area are probably also intrusive into the metavolcanics.

The porphyritic metagabbro sill (dike?) near Elga Lake has been described with the other porphyritic mafic to intermediate metavolcanics (see section on "Mafic to Intermediate Metavolcanics"), but may be part of these later Mafic Intrusive Rocks because the matrix appears to be slightly less recrystallized than that of the other localities of porphyritic rocks.

Felsic Intrusive Rocks

Felsic intrusive rocks were subdivided into (1) Metamorphosed Felsic Intrusive Rocks, (2) Foliated Felsic Intrusive Rocks, and (3) Massive Felsic Intrusive Rocks. Their classification was based on:

(1) Degree of alteration.

(2) Nature of the contact with the host rocks.

The Metamorphosed Felsic Intrusive Rocks are generally small in area and are highly altered.

Foliated Felsic Intrusive Rocks are only moderately recrystallized, passively intruded, and batholithic in size (greater than 10 to 15 square miles; 26.9 to 38.9 km^2).Inclusions of the country rock are more common in these rocks than in the

TABLE 4 | **MODAL ANALYSES OF FELSIC INTRUSIVE ROCKS FOR McCUBBIN, POISSON AND McGILLIS TOWNSHIPS.**

	1	2	3	4	5	6
Plagioclase	44.4	38.5	53.7	66.2	47.4	53.0
Potassium feldspar	15.2	-	7.9	-	0.9	-
Quartz	29.4	46.9	33.1	19.0	35.0	27.6
Biotite	6.6	0.4	2.5	0.4	-	12.4
Muscovite	0.1	5.3	0.1	-	1.4	-
Chlorite	-	7.0	0.6	7.8	6.0	-
Carbonate	-	-	-	-	3.0	0.2
Epidote	3.7	-	1.5	6.0	6.3	6.3
Sphene + Zircon	0.4	1.6	0.4	0.6	-	-
Opaques	-	-	0.2	-	-	-
Allanite	-	-	-	-	-	0.2
Number of points counted	1000	1000	750	500	750	500

Notes
1 - Grebe Lake Stock
2 - Granitoid boulder in conglomerate north of Kashaweogama Lake.
3 - Porphyritic granodiorite stock north of Whimbrel Lake.
4 - Fine-grained border phase of Heron Lake Stock (sample B8-70).
5 - Coarse-grained quartz-rich phase of Heron Lake Stock (sample B8-73).
6 - Biotite-rich centre of Heron Lake Stock (B8-79).

Abbreviations
- Not detected

intrusives of the other categories.

The Massive Felsic Intrusive Stocks are massive, the least altered of the Felsic Intrusive Rocks, and are generally small in area (10 to 15 square miles or less). These youngest felsic intrusive rocks have generally been forcefully intruded, causing deflections in the "primary" structural trends of supracrustal rocks.

Thin section examination of felsic intrusive rocks shows that with an apparent increase in their age:

(1) Plagioclase is progressively more altered with twinning being progressively more destroyed.

(2) The amount of granulation and recrystallization increases.

Modal analysis of all granitic rocks are given in Table 4.

METAMORPHOSED FELSIC INTRUSIVE ROCKS

A complex trondhjemitic stock outcrops north of Kashaweogama Lake, and will be referred to in the succeeding text as the Heron Lake Stock. Based on texture and mineralogy, three different phases in the stock are recognizeable. The relationship and extent of these phases is not known, and further detailed field examination is required.

Part of the border phase along the southern boundary of the Heron Lake Stock is composed of fine-grained massive trondhjemite. The inner part of the Stock is coarser grained than the border phase, and is medium grained, quartz poor, and weakly foliated. A coarse-grained, quartz-rich, massive, leucocratic trondhjemite outcrops along the northern and eastern margins of the stock; the quartz forms large subhedral to euhedral crystals that locally are steeply sublineated. The contacts between these phases of trondhjemite are apparently gradational. Modal analyses of the fine-grained leucocratic (quartz-poor) trondhjemite, the coarse-grained leucocratic (quartz-rich) trondhjemite and the core of the stock are given in Table 4, Sample numbers 4, 5, and 6 respectively. Chemical analyses of all three phases are given in Table 3, numbers 3, 4, and 5. It should be noted that the modal and chemical analyses of the central part of the stock were done on different samples.

Plagioclase, quartz, and chlorite comprise the major components of the fine-grained leucocratic trondhjemite. Plagioclase occurs as subhedral to anhedral randomly oriented laths (1mm) which form glomerating patches at a few places. Twinning has probably been destroyed by metamorphism (Spry 1969) and the laths of plagioclase are heavily clouded with saussurite and sericite. Chlorite forms anomalous brown birefringent anhedral, platy aggregates. Quartz is present in thin section to a minor extent, but is not evident in the field. In thin section, the quartz is highly recrystallized into minute granules filling interstices between the plagioclase. Sphene is the most common accessory mineral.

Along part of the northern and eastern margins, and along a zone immediately north of the previously described fine-grained border phase, a coarse-grained, quartz-rich trondhjemite outcrops. A modal analysis of the rock is given in Table 4, sample number 5. Quartz forms subhedral crystals laminae up to 5 mm across that stand up in moderate relief against the matrix. Locally, the quartz is sublineated; at a few places the quartz forms lenticles that appear to be joined, similar to a honeycomb network. Plagioclase grains (5 mm) constitute much of the remaining volume of rock. Plagioclase is anhedral to subhedral and highly sericitized; twinning is rare, and where present is only vaguely defined. The plagioclase is cut by numerous microfractures along which mortar textures are common. Chlorite forms aggregates, and is spectacular for its anomalous blue birefringence colours; it is often intergrown with biotite. Quartz and plagioclase are the dominant components within this phase, and form at least 80 percent of the total volume. The rock exhibits a hypidiomorphic equigranular texture with very little intervening matrix. The texture and mineralogy of the rock is remarkably similar to that of the trondhjemite boulders within the adjacent granitoid boulder-bearing polymictic orthoconglomerate.

In the central part of the stock, the rock is medium grained, and locally is more biotite-rich with an accompanying foliation. A modal analysis of this more biotite-rich part is given in Table 4, number 5. The chemical analysis of the core rock (Table 3, analysis 5) was done on a sample containing only a small percentage of biotite. Perhaps the more biotite-rich parts are the products of resorbed stoped blocks of the country rock.

Rocks of the Heron Lake Stock are extensively sericitized, and are the most intensely metamorphosed granitic rocks that have been observed by the author

in the Savant Lake area.

Although the Ontario Division of Mines 1 inch to 4 mile scale compilation map (Davies *et al.* 1970) shows this stock to be part of a larger batholith to the northwest, it is probably a separate small stock. The coarse texture, abundance of quartz, and the fact that there is little intervening matrix suggest that this is a high level, low temperature intrusive body. The fairly intensive metamorphism suggests also that this is a pretectonic intrusive body, possibly related to the volcanism in the area. Compositional similarity with the granitoid clasts in the polymictic orthoconglomerate to the south suggest that the Heron Lake Stock may be the source of these clasts. Mapping of this orthoconglomerate to the west along Kashaweogama Lake (Bond 1974) has shown that the coarse-grained granitoid clasts are definitely most plentiful in the vicinity of Heron Lake. Grain size in the stock increases progressively from south to north, and indicates probable crystallization of the stock *in situ*. The finer grained phase in the south probably represents the roof of a magma chamber, whereas the coarser phases in the north probably represent progressively deeper levels in the magma chamber. These features suggest a south facing top direction for the stock that indicates that the stock is basal to the orthoconglomerate; more field work is required to verify this. On the map the Heron Lake Stock has been shown to intrude the conglomerate, with the fault contact bewteen the metaconglomerate and mafic to intermediate metavolcanics terminating against the margin of the intrusive.

Three chemical analyses (see Table 3, numbers 3,4, and 5) of samples from the Heron Lake Stock indicate that aluminum, total iron, magnesium and calcium all decrease towards the core of the stock, while silica and potassium increase from the rim to the core. These trends are related to a decrease in ferromagnesian minerals accompanied by an increase in quartz content towards the centre of the stock. This is a normal expected crystallization sequence suggesting that the stock crystallized from the margins inward. However, more than three samples are needed before drawing further conclusions.

Quartz and quartz-feldspar porphyry are also included within the Metamorphosed Felsic Intrusive Rocks. These rocks are present as sills and dikes at Hazel Lake, north of Barnum Lake and on the northwestern shore of Savant Lake east of the tourist lodges. The quartz crystals are distinctly blue in these rocks and are enclosed in a fine-grained, highly recrystallized dark grey matrix that is grey on both the fresh and weathered surfaces. Plagioclase is present as fine-grained randomly oriented laths along with the quartz in the sill on the northwestern shore of Savant Lake.

FOLIATED FELSIC INTRUSIVE ROCKS

The two granitic areas in the northeastern and southeastern parts of McGillis Township respectively are parts of two lobes of a large granitic batholith which lies to the east of the map-area. Compositionally, the rock is fairly homogeneous, and is a biotite granodiorite (locally, quartz monzonite). On a horizontal outcrop surface, the rock is massive in appearance, but on inclined to vertical surfaces the rock is foliated. The foliation arises from the alignment of flakes and

ODM9508

Photo 15–Biotite-rich xenolith in the granodiorite batholith from the southeast corner of Elga Lake. Pencil is about 7 inches (18 cm) long.

aggregates of biotite. The rock weathers light pink to white, and is generally medium grained, but is coarse grained in spots. Aplite is fairly common as dikes. Shearing is locally found along the margins of the pluton. Thin, (1 to 2 inches; 2.5 to 5 cm) quartz veins are abundant near the margin of the intrusive body in the extreme southeastern corner of McGillis Township.

Near the southeastern corner of Elga Lake there are numerous xenoliths in the granodiorite (Photo 15). The xenoliths have a common trend of about S65°E, and are subparallel to the contact of the granodioritic body at that point. The xenoliths are biotite-rich and fine grained, range in size from 1½ (3.8 cm) to 4 feet (1.2 m), are stretched, about 2:1 ratio of length to thickness, and are rounded to rarely subangular. The margins of the xenoliths vary from being reasonably sharp to diffuse, the latter is due to resorption by the host. Several appear to be plastically deformed while, more rarely, a few appear to have remained brittle and are fractured and faulted. In the latter cases, invasion of younger granitic material is apparent along the fractures. One occurrence was seen in which a xenolithic block had been fractured and invaded by granitic material with no dispersion or rotation of the fractured xenolithic parts. Feldspar grains, (2 to 3 mm in size) occur as laths uniformly distributed throughout the biotite-rich inclusions. The feldspar grains are parallel to the biotite flakes which are in turn parallel to the trend of the long axis of the xenoliths.

The contact of the granodiorite lobes is marked by a well-defined lineament on the 1-inch to ¼-mile scale (1:15,840) air photographs. Exposure is generally poor except along the margins of the lobes. The first 50 feet (15 m) of the mafic to intermediate metavolcanics in contact with the granodiorite in the extreme southeastern corner of McGillis Township is marked by much epidote alteration

and numerous granodiorite and aplite dikes and stringers.

The rocks of the batholith are composed of 40 percent plagioclase, 15 percent potassic feldspar, and 30 to 35 percent quartz, the remainder is composed mainly of biotite, epidote, sphene and sericite, and therefore are comparatively near the dividing line between granodiorite and quartz monzonite.

Plagioclase (up to 6 mm) is subhedral, and zoned with more calcium-rich sericitized inner zones and more sodium-rich borders that are relatively unaltered. Twinning within the plagioclase has been destroyed by metamorphism and is absent (Spry 1969). Quartz and microcline feldspar are unaltered and interstitial to, and are easily distinguished from plagioclase. The quartz crystals are unrecrystallized but are traversed by well spaced fractures. Microcline is typically anhedral and commonly exhibits string perthite. Biotite is tabular, and typically strongly pleochroic from dark brown to light brown. Individual tabular biotite crystals are randomly oriented, but are often concentrated into loosely packed clusters. These biotite clusters appear to be randomly oriented in both thin section and hand specimen. Sphene and apatite are minor accessories.

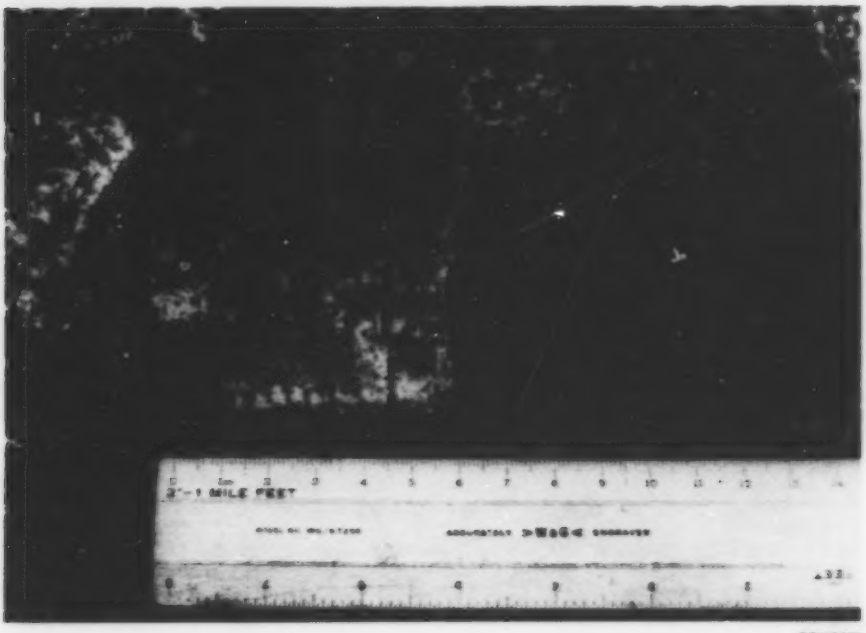
MASSIVE FELSIC INTRUSIVE ROCKS

There are two small stocks of late felsic intrusive rocks in the map-area. One is situated north of Whimbrel Lake and is spectacular for its porphyritic texture. The other stock is a massive granodiorite situated in the vicinity of Grebe Lake.

Porphyritic Granodiorite

The regional map (see Davies *et al.* 1968) shows that the greater part of the porphyritic granodiorite stock north of Whimbrel Lake lies outside the map-area, its centre being situated in Benner Township directly north of Poisson Township. Overall, the form of this granitic body is lenticular with the long axis trending approximately N60°E. The length of the long and short axes of the stock is about 5 miles (8 km) and 2.5 miles (4 km) respectively. Only about a third of the total volume of the stock lies within the map-area in northeastern McCubbin Township and northwestern Poisson Township. The part of the stock in the map-area is poorly exposed, and much of the contact has been interpreted from aerial photographs and the trend of the geophysical contours shown on the aeromagnetic maps of the map-area (ODM-GSC 1961a, 1961b). No apophyses of this felsic intrusive were observed in the exposed rocks near the contact. In two areas where the contact was established fairly closely, no contact aureole was observed, although shearing is apparent in the host metavolcanics.

The rock is spectacular for its occurrence of porphyritic megacrystals of microcline feldspar (Photo 16) which form 5 to 8 percent by volume of the rock. The phenocrysts of feldspar range in size from 1 to 6 cm in length, and from 0.25 to 3 cm in width. These phenocrysts are randomly oriented, and regularly distributed throughout a massive homogeneous, medium-grained (4 to 5 mm) groundmass. The majority of the megacrysts exhibit a concentric internal



ODM9509

Photo 16–Porphyritic granodiorite with coarse zoned microcline feldspar phenocrysts up to 6 cm. The ruler is approximately 4.5 inches (10.4 cm) in length.

structure, and this may be caused by selective alteration arising from internal zoning. Minute biotite inclusions are oriented parallel to some of the alteration rings. The margins of this stock are devoid of the megaphenocrysts, and contain metavolcanic inclusions.

The rock weathers pink, and is invariably pink on the fresh surface. The mafic minerals, biotite, present as books, and chlorite, constitute about 5 percent of the rock and on the whole, the rock is leucocratic.

The rock is a granodiorite and the matrix consists essentially of plagioclase (oligoclase An_{13} to An_{17}) quartz, minor microcline and biotite. Chlorite, muscovite, and epidote are also present in minor amounts as well as trace amounts of opaques and sphene. A modal analysis of one sample is given in Table 4, number 3.

Plagioclase in the matrix is subhedral to euhedral, inequigranular (1 mm to 5 mm), and moderately altered to sericite, granular epidote and carbonate. From one third to a half of the plagioclase alteration is restricted in its occurrence to concentric zones of rings within the laths and reflects oscillatory zoning. A maximum of three alteration rings separated by non-altered complimentary rings were observed in thin section. Quartz is subhedral to euhedral, characterized by curved to sutured boundaries, and is traversed by widely spaced fractures. Microcline is interstitial, anhedral and commonly exhibits flame perthite, is only slightly altered, and has the characteristic microcline twinning. Biotite, present in hand specimen as books up to ⅛ inch (3 mm) in diameter, is regularly distrib-

uted throughout the rock along with smaller amounts of closely associated chlorite. Epidote is present as anhedral aggregated and euhedral crystals both within the plagioclase and in the interstices. Opaque minerals (mostly magnetite) and sphene are spatially associated with the ferromagnesian minerals.

Numerous boulders, up to 5 feet (1.5 m) in diameter, of this rock were found scattered throughout McCubbin Township, and were deposited by the glaciers.

Grebe Lake Stock

South of Kashaweogama Lake and east of Highway 599 in McCubbin Township, a small stock is present in the vicinity of Grebe Lake on the southern edge of the map-area. Only a small part of the northern margin of the stock is present in the map-area because most of the stock lies within the northern part of Conant Township (Bond 1973a) situated directly south of McCubbin Township.

In the field, the rock is medium to fine grained, massive to slightly foliated, and is slightly richer in biotite than the stock to the north of Whimbrel Lake. The rock weathers pink and is generally pink to grey on the fresh surface. Inclusions are present locally. A narrow contact aureole characterized by abundant biotite was observed along the margin in the greenschist facies metasedimentary hosts. The metasediments are locally sheared near the contact. The contact is nearly concordant to the metasedimentary country rocks which wrap around the margins of this pluton.

The rock is a granodiorite in composition, but local variations to quartz monzonite are present. Feldspar and quartz constitute 90 percent of the rock with ferromagnesian minerals accounting for the remainder. A modal analysis is given in Table 4, number 1. The margin is slightly finer grained than the interior. Marginal plagioclase is oligoclase An_{18}; it is anhedral to subhedral, only moderately altered to sericite, epidote and carbonate, and appears unzoned. Microcline is anhedral and interstitial to the plagioclase and quartz; it often exhibits microcline twinning and is further characterized by the presence of flame and string perthite. A few of the microcline feldspars contain, and are replacing plagioclase. The borders of both types of feldspar are somewhat corroded. Quartz is anhedral and forms in large aggregates (up to 3 or 5 mm in diameter) composed of several individuals through granulation.

Biotite (approximately 8 to 10 percent) is the most common ferromagnesian present, forms plates, and is recrystallized by varying amounts. In addition, chlorite, epidote, and sphene are present as accessories with magnetite, hematite, apatite, allanite, and zircon being present in traceable amounts.

LATE PRECAMBRIAN

Mafic Intrusive Rocks

Diabase dikes are scarce in the map-area and only four occurrences are known, all in the granitic batholith underlying northeastern McGillis Township. Trending between N50°E and N65°E, they dip vertically to 80 degrees to the

northwest. The dikes range in width from 10 to 50 feet (3 to 15 m) depending upon irregularities in the margins. Where observed, the contacts are sharp and vary from straight to curved to rarely wedged. Chilled margins were found to vary from 6 inches to 1 foot (15 cm to 0.3 m) in thickness.Owing to poor exposure, the dikes were traceable along strike for only short distances (600 feet (180 m) maximum) and the four occurrences seem to represent four separate dikes.

The dikes typically weather dark green, to locally brownish and are dark grey-green to black on the fresh surface. No differential weathering between the dikes and the host granitic rocks was observed. The rocks consist of equal amounts of plagioclase (up to 1 mm), and mafic minerals. The host rocks at the contact of the dikes are non-schistose, but are slightly pinker than normal.

One other mafic dike which is possibly diabase occurs in central McCubbin Township about 300 feet (90 m) west of Highway 599. The dike is 5 inches (13 cm) wide, trends northwest, and is traceable across the host outcrop for a distance of 200 feet (60 m). The dike is gabbroic with laths of plagioclase up to 2 mm long. It cuts felsic to intermediate coarse pyroclastic rock and has a small (approximately 1 inch - 2.5 cm wide) chilled margin.

Phanerozoic

CENOZOIC

Quaternary

PLEISTOCENE

Extensive Pleistocene deposits cover much of the underlying bedrock. The deposits are substantial enough that, except for the trend of the lakes, in most parts of the map-area, the surface relief does not reflect the stratigraphy and structure of the underlying lithologic units. The level of Savant Lake fluctuates about the 1,300 foot (400 m) mark above sea level, and the topography including Pleistocene deposits, rises to a maximum of about 200 feet (60 m) above this. The most extensive glacial deposits occur west of Savant Lake, while to the east of the lake, the glacial till is covered by recent deposits of muskeg and sand to silt accumulations.

Glacial striae are found on most exposures, but are most prominent on lake shore exposures and in the metasediments to the west of the lake. They indicate the general direction of the last ice movement to be toward the south-southwest and average from S28°W to S30°W. Although the general southwesterly trend exhibited by most of the lakes in the map-area coincides with the general direction of ice movement, the strike of these lakes appears to be more closely tied with the trend of the underlying lithologies.

Fluting is found in the map-area, and characteristically has its long axis sub-

parallel to the direction of ice movement. Approximately eight flutes with adjacent low profile ridges occur in the area between Whimbrel Lake and Savant Lake. They are traceable for about 7 miles (11 km), originating out of the map-area north of Poisson Township on the western shore of Savant Lake. The ridges are regularly spaced at approximately 1,000-foot (300 m) intervals and are easily seen on regional air photos because of the association of deciduous trees which grow on the ridges. Varying from 200 to 400 feet (60 to 120 m) wide, the ridges attain a height of between 10 to 50 feet (3 to 15 m). Fluting is also prominent in northwestern McGillis Township originating along the northeastern shore of Savant Lake and extending for about 4 miles (6 km) to the south towards Leggo Lake. These ridges are up to 100 feet (30 m) wide and have a low relief of 20 feet (6 m). In the field, the surface of the ridges is marked in places by a concentration of boulders which may represent a lag concentrate formed from former wave washing or formed from ice-rafting of boulders. Several of the islands in Savant Lake are composed of boulder and sandy till and may be in part ridges that have resulted from fluting.

The only extensive moraines deposited in the area appear to have been formed transverse to the direction of ice movement and are commonly known as ribbed moraines (Prest 1968). Most are straight to gently arcuate, and are discontinuously traceable over distances of up to 2 miles (3.2 km). Ribbed moraines are common between tha arms of Whimbrel Lake, between Whimbrel Lake and Savant Lake, and in much of the north-central part of McGillis Township associated with the drumlinoid ridges, an association also reported by Prest (1968). These ribbed moraines average about 100 feet (30 m) wide at the base, are generally 20 feet (6 m) high, and average about 1 to 1¼ miles long (1.6 to 2 km). They occur in groups of about 25 or more in two main occurrences, and are regularly spaced, with the distance from crest to crest being a constant 500 feet (150 m). The moraines are composed of unsorted sandy till, boulders and cobbles.

Glacial till is generally sandy in texture, and is composed of boulders of variable lithologies which generally reflect the composition of local underlying rocks. Oolitic hematite pebbles are common, but are not of local derivation. Zoltai (1965) reported the till in the vicinity of Savant Lake to be composed of 90 percent sand particles, 10 percent silt and negligible clay. The larger proportion of sand grains are from 0.25 to 0.1 mm in diameter. Large free boulders are generally of local derivation and boulders of the porphyritic granodiorite in northern Poisson Township are strewn throughout McCubbin Township (southwest of the porphyritic grandiorite pluton).

The sand and gravel deposits are fairly extensive in central McCubbin Township. Covering an area of about 1 mile by 1½ miles (1.6 by 2 km) along with other scattered deposits, they probably represent an outwash plain of glaciofluvial origin. Fine, stone-free, well-sorted sand is predominant in central McCubbin Township, although local gravel deposits are present, and are being used by the Department of Highways of Ontario in the northern part of the township.

No varved sediments or other evidence of glaciolacustrine deposits were found, although the area was covered by glacial Lake Agassiz. The history and extent of the lake is described by Zoltai (1965). Evidence of the lake is seen only by the probable reworking of the moraines by which waves formed concentrations of boulders along some of the ridges.

RECENT

Recent accumulations consist of sand, silt, and gravel deposited locally by streams, and organic mud deposits associated with muskegs. The wet, partially open muskegs are distinctive in outline on the airphotos, and are useful for navigation control on overland traverses. Muskegs are almost perfectly flat, and are only sparsely populated by stubby trees. The drier areas of muskeg west of Virginian Lake and in northern McCubbin Township are characterized by spongy dried moss and trees of low stature. The recent swamp and muskeg areas are generally isolated, poorly drained, and are most prolific east of Savant Lake.

CORRELATION OF GEOLOGY WITH AEROMAGNETIC MAPS

ODM-GSC Aeromagnetic Maps (1961a, 1961b) published at a scale of 1 inch to 1 mile (1:63,360) are available for the area.

Two extremely large anomalous zones are clearly discernible over the area underlain by the Ferruginous Metasediments. The magnetic intensity of the zone in the southwestern part of McCubbin Township is as high as 80,000 gammas, and is the strongest, while the zone along the western shore of Savant Lake is as high as 75,000 gammas. Owing to the strength of these anomalous zones, attempts to interpret the structure from this data are extremely limited in that most other magnetic features are masked by these zones. The aeromagnetic data confirms the overall triangular form of the iron formation-bearing metasediments underlying Poisson Township. The anomalous zones are strong enough to cause as much as 15 degrees deviation of the compass to the west (3 miles, 4.8 km) across the lake in McGillis Township.

Exposure is poor south of Kashaweogama Lake. The abrupt termination of the aeromagnetic high in the vicinity of the eastern end of Kashaweogama Lake supports the interpretation by the author that there are no ferruginous metasediments in this area as suggested by Rittenhouse (1936) who showed iron-bearing zones as two completely separate bands. Field evidence and aeromagnetic data in the vicinity of Snowbird Lake however indicate that the iron formation is continuous in this area having been folded, and that it does not form two separate bands as proposed by Rittenhouse (1936). It appears from the intensity of the aeromagnetic contours on the map that the highest iron formation to arenaceous metasediment ratio within the ferruginous metasediments is located in the area southwest of Kaskaweogama Lake and around Snowbird Lake, and this was substantiated during the field investigation. Of interest is the high (64,000 gammas) anomalous zone near the east shore of Savant Lake situated about two-thirds of the way north up the Poisson-McGillis township line which may indicate that the metasediments extend over to the east that far, and that the contact between the metasediments and metavolcanics and/or conglomerate is in fact just off the east-central shore of Savant Lake.

In most instances, the correlation is quite remarkable; for example, the tuffaceous metasedimentary zone occurring on the eastern shore of Whimbrel Lake and the non-ferruginous greywacke band occurring in the centre of the ferruginous metasediments in the vicinity of One Pine Lake (local name) are both

discernable on the aeromagnetic map. The contacts of the smaller granitic stock correlate fairly well with the associated magnetic contour pattern and the western part of the porphyritic granodiorite in northeastern McCubbin Township is drawn on the basis of the pattern and intensity of the aeromagnetic data.

STRUCTURAL GEOLOGY

The structure of the area is complex. The earlier geologists (Moore, Rittenhouse and Skinner) all recognized that the most dominant feature is the synclinal structure outlined by the metasediments to the west of Savant Lake, but, from the current mapping program, it seems the structure is much more complex than these geologists envisaged.

Foliation, Schistosity, and Cleavage

Foliation (the subparallel alignment of platy minerals) is found sporadically throughout the metavolcanics and, where present, is generally subparallel to the trend of the stratigraphy. It is localized, and often spatially associated with contacts (between massive flows and pillow lavas) and highly schistose zones. For the most part, the pillow lavas and flows are massive. The foliation symbols associated with the metasediments actually represent a slaty cleavage that prevades this sequence.

Schistosity is locally developed throughout the map-area, especially in the immediate vicinity of contacts of flows and along cleavage planes. Schistosity is intensive and penetrative in four main areas: (1) along the eastern shore of Savant Lake in northwestern McGillis Township and inland from there for about 1,500 feet (460 m); (2) along the north shore of Kashaweogama Lake extending up to the polymictic orthoconglomerate; (3) associated with the Savant Lake Fault on some of the islands in Savant Lake in south-central Poisson Township, and; (4) at the contact of the granitic batholith in McGillis Township. Schistosity is also locally developed in the felsic to intermediate metavolcanics north of Whimbrel Lake, and is often concentrated along fairly widely spaced fracture planes that may have originated during the regional metamorphism.

Slaty cleavage, developed throughout the metasediments, is related to the folding and is present as well-developed fractures 2 to 3 mm wide spaced from 2 to 8 cm apart. Towards the nose of the fold occurring along the western shore of Savant Lake and in most of southwestern Poisson Township the slaty cleavage strikes at a high angle to the bedding. At a few places where the angle is high, regularly spaced small pits caused by weathering at the intersection of bedding and cleavage are common. The tiny pit structures generally form in the coarser grained part of the metasedimentary beds,while in the finer grained part, if the pitting is present, the pits are smaller and more closely spaced. Several of the pitted or chip zones are curved owing to refraction of cleavage caused by change in grain size. A fracture cleavage is also locally found in the felsic metavolcanics and may be related to the slaty cleavage.

Folding

The outcrop pattern of the metasediments shows that the area has been complexly folded. Moore (1928) considered that the mafic to intermediate metavolcanics east and west of Savant Lake were correlative and folded into a regional syncline. However, Rittenhouse (1936) noted that the mafic to intermediate metavolcanic sequence north of Kashaweogama Lake faced away from the proposed synclinal axis. The present mapping program, through field evidence, supports Rittenhouse's (1936) appraisal. Tops from pillow lavas indicate the mafic to intermediate metavolcanic sequence north of Kashaweogama Lake faces north. To the east of Savant Lake, tops of pillow lavas indicate that the mafic to intermediate metavolcanic sequence north from Leggo Lake in McGillis Township are overturned and face northwest. A minor synclinal axis running along the unnamed lake between Leggo Lake and Pride Lake with a complimentary anticlinal axis in the vicinity of Leggo Lake is thought to exist. Evidence for the synclinal axis is two-fold: (1) reversal in top direction as indicated from pillow lavas; and (2) reversal in direction of dip, south from the axis the foliation dips are to the north whereas to the north of the axis the dips are generally to the south. To further support the existence of a syncline, the pillow units appear to be folded near Virginian Lake. However, the distortion of the pillows at Virginian Lake may be caused by the intrusion of the granitic batholith to the east.

The metasediments appear to be more complexly folded; whether the felsic to intermediate metavolcanics have been folded remains to be determined owing to the general lack of marker horizons. The few visible lithological trends are generally east-west. The bedding in the felsic to intermediate metavolcanics on Highway 599 trends north- south; this may just be a local slump deposit, although it may also indicate the true trend of the sequence which may be the same as the porphyritic granitic stock north of Whimbrel Lake. The rhyodacitic tuff-breccia exposed on the two small islands west of Girard Island in Savant Lake may be continuous with the felsic to intermediate metavolcanic sequence north of Whimbrel Lake because of folding.

The nature of folding is accentuated by the outcrop pattern of the iron formation-bearing metasediments. These rocks form a continuous, nearly closed triangular band that is similar to the superposed fold patterns described by Ramsay (1962). According to Ramsay (1962, p.479) the basic geometry of any superposed fold is primarily dependant upon the direction of movement of the second phase of folding in relation to the orientation of the axial plane of the first phase of folding. Also, the intensity of each folding event is reflected in the shape of the resulting fold pattern. The distribution pattern of the metasediments in the present map-area is similar to Ramsay's (1962) Type 2 pattern in which the axes of the two phases of folding are at relatively high angles to one another.

The early phase of folding has nearly horizontal axes, and is represented by the anticlinal and synclinal axes that trend parallel to the bedding in the lower part of the metasedimentary sequence just southeast of One Pine Lake along the western shore of Savant Lake. These axes are found running through several of the islands in Savant Lake in southern Poisson Township. The anticlinal axis located 0.75 miles (1.2 km) south of Cat Track Lodge is probably a continuation of

one of the anticlinal axes crossing these islands in southern Poisson Township, but lack of exposure prevented exact correlation. Evidence for the axis is based on changes in direction of graded bedding. This folding however, also explains the presence of the repetitive (isoclinally folded) lenses of non-iron formation-bearing metasediments that are interlayered with the lower ferruginous metasediments in this part of the map-area. These latter non-iron formation-bearing sequences could also just represent facies changes. South of the north arm of Whimbrel Lake, the sequence faces south, and there are no interlayered arenaceous metasediments within the sequence. The termination of the anticlinal and synclinal axes as they strike towards Whimbrel Lake may be caused by faulting. There is one outcrop in this area in which the beds face north, but the nearby beds on strike with this exposure face south, and this reversal is thought to be caused by primary reversed grading that has taken place during the turbidite deposition (Roy Shegelski[1], personal communication 1973).

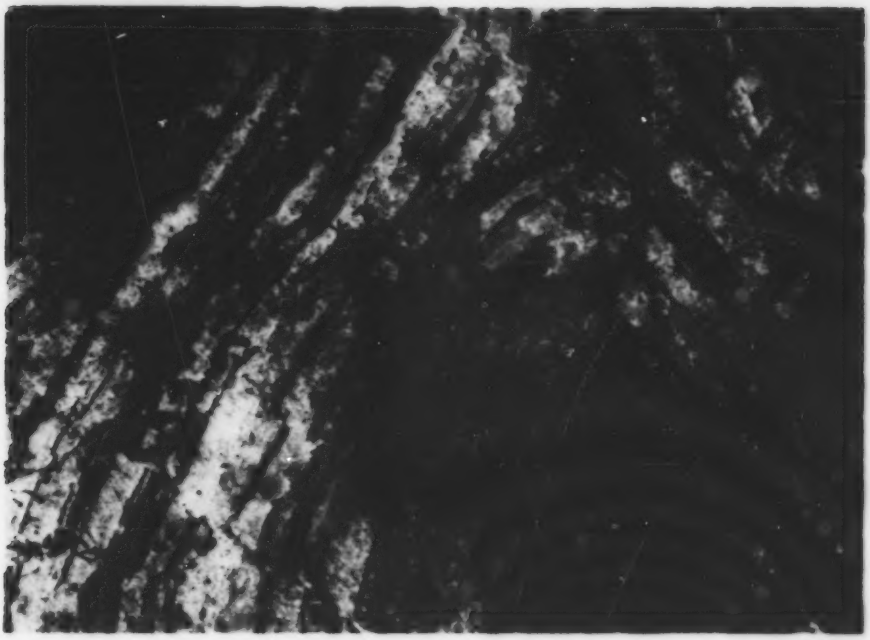
A later phase of folding trending approximately east-west was superposed upon the first phase at a fairly high angle; the axis of this folding is nearly perpendicular to the axis of folding of the first phase. The axial plane of this second phase of folding corresponds to the formal axis running through the eastern part of Kashaweogama Lake. Further east, this same fold axis curves northeastward and this is probably related to the form of the folding.

According to Ramsay (1962, p.473), if two distinct periods of deformation form the superposed pattern, then there should be two sets of cleavages and two widely differing plunges of parasitic minor folds, each representing one of the two periods of folding. Within the metasedimentary sequence there appears to be only one axial plane cleavage present and only one set of minor folds present; both of these are exposed on the plan (horizontal) surface and reflect the later phase of folding. This suggests that the folding took place during a single period of deformation.

Based on the strike and dips of bedding and minor fold structures the folded metasedimentary sequence plunges steeply to the northeast forming a synformal structure. The east limb of the major synformal fold is overturned. Minor fold structures in the metasediments in the northeastern part of Poisson Township plunge to the southwest, but are probably related to the intrusion of the granitic stock in northwestern Poisson Township. The iron formation is the least competent member within the ferruginous metasediments, and most of the drag folds were observed in it. However, some of these minor folds involve several beds, and are of substantial size (Photo 17). The minor folds appear to be mostly post-consolidation deformational features. Along the western shore of Savant Lake, some of the drag folds may be related to movement along the main fault running down Savant Lake.

The iron formation-bearing metasediments in the southwestern corner of McCubbin Township form an isoclinally folded syncline trending approximately N70°W. Mapping to the south in Conant Township, Bond (1973a) indicates that this syncline plunges steeply to the west-northwest. Lack of exposure obscures the relationship of the ferruginous metasediments in the southwestern corner of McCubbin Township to the iron formation-bearing metasediments of Poisson Township.

[1]Ph.D. candidate, University of Toronto.



ODM9510

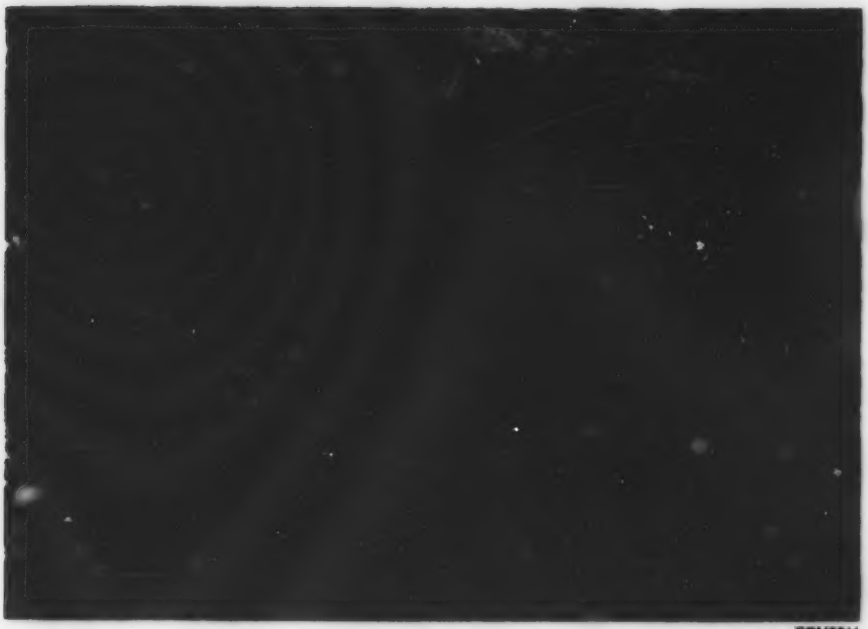
Photo 17–Minor fold within the ferruginous metasediments from the west shore of Savant Lake near the nose of the fold. Pen in centre of picture is about 5 inches (13 cm) long.

Faulting

Faulting has affected the area to varying degrees. Minor local faults with displacements of 0.5 to 2 m (1.6 to 6.6 feet) are common throughout the metasediments and generally trend transverse to, or at a fairly high angle to, the strike of the bedding (Photo 18). These small-scale faults are probably present in the metavolcanics in the area, but are not as apparent because of lack of marker horizons. The minor faults probably accompanied the major folding. The faults are generally clean and sharp with no associated shearing or silicification.

Several major faults do exist and have played an important role in the overall geological picture. Table 5 lists the major faults and summarizes the field evidence used to establish them. Rittenhouse (1936) was the first to describe several of the major faults in the area. The major faults generally trend northeast.

Perhaps the most widely recognized fault is the Savant Lake Fault. There is intense shearing in the metasedimentary and metavolcanic sequences on either side of this fault, especially in the vicinity of the south end of Girard Island. The disappearance of the polymictic orthoconglomerate containing granitoid clasts



OOM9511

Photo 18–Minor displacement in the metasediments. From the lower part of the ferruginous metasediments on the west shore of Savant Lake. Pencil is about 6.5 inches (16.6 cm) long.

in northeastern Poisson Township also implies the presence of a major offset. The change in structural trend from the more northerly trending metasediments to the more east- to northeast-trending metavolcanics across the fault may also indicate faulting, although this can also be explained by an unconformity.

North of Kashaweogama Lake, the fault which separates the mafic to intermediate metavolcanics from the conglomeratic metasediments and the felsic to intermediate metavolcanics is based upon a complete reversal of facing of map units there. Pillow-top determinations show that the mafic to intermediate metavolcanics face north, while the metasediments north of Kashaweogama Lake face south. Lumbers (1962) noted a similar relation in Lake Abitibi except, there, the metavolcanics and metasediments face each other. Pyke *et al.* (1971) appealed to faulting to explain this structure. Folding cannot explain this relationship because there is no repetition of the lithologic units on either side of the fault zone which would be expected if folding had occurred. A simple unconformity is unlikely because this would mean the metavolcanics would have been completely overturned before sedimentation began. The fault has been shown ending against the Heron Lake Pluton, although it may in fact continue along the southern boundary.

North of the eastern end of Kashaweogama Lake, faulting has probably ab-

TABLE 5 | FIELD EVIDENCE USED IN POSTULATING MAJOR FAULTS IN McCUBBIN, POISSON, McGILLIS TOWNSHIPS.

	Type	Movement	I	II	III	IV	V	VI
Savant Lake Fault	longitudinal			x	x		x	x
Kashaweogama Lake Fault	transverse	graben?	x	x	x			x
Fault cutting Wiggle Creek	transverse	rotational	x					
Fault Contact of metavolcanics-metasediments* in McCubbin Township	longitudinal	vertical?				x		
Northwest McGillis* (Fault associated with conglomerate)	transverse	sinistral?	x	x				
North of Whimbrel Lake (2 faults)	transverse		?	x				

Notes

I- At abrupt stratigraphic offset
II- Abrupt disappearance of lithologies
III- Intense shear zone associated
IV- Reversal of tops across fault
V- Change in trend of lithologies across faults
VI- Topographic features (lineament)
*- possibly explained as unconformity

Abbreviations

x- Item present

ruptly displaced the metaconglomerate and ferruginous metasediments. These faults have been interpreted by the writer as splay faults splitting off the previously mentioned fault separating the mafic to intermediate metavolcanics in the north from the metasediments and felsic to intermediate metavolcanics to the south. No topographic expression, or shearing was observed to accompany these faults, although extensive shearing of the rocks along the northern shore of Kashaweogama Lake may signify that the more westerly of these two splay faults eventually curves and strikes along Kashaweogama Lake. Rapid facies change could also account for the disappearance of the polymictic orthoconglomerate and ferruginous metasediments in this same area, although the percentage of iron formation to the east of the fault is substantially higher than in the area to the immediate west. That is, the depletion of iron to the west of the fault is very complete and sharp, with no magnetite concentrations occurring whatsoever.

The linear trend of the southern arm of Whimbrel Lake, and the abrupt disappearance of the felsic tuff underlying the area east of the lake may be the result of a fault in this zone, although this could also be rapid facies change. The lack of offset of the contact between the arenaceous and the ferruginous metasediments just south of this massive felsic tuff unit suggests that rapid facies change is a more plausible explanation here.

The placing of other faults north of Whimbrel Lake and in northwestern McGillis Township is based on the abrupt disappearance of certain map-units.

ECONOMIC GEOLOGY

Gold, iron, and copper are associated with sulphide minerals, and have been the most economically interesting minerals in the map-area to date. The emphasis has been on the first two metals during most of the prospecting history. Zinc and nickel are found locally, but only in trace amounts. Pyrite and pyrrhotite are of less importance. Gold-bearing arsenopyrite is present at one locality. Pyrite is ubiquitous throughout the metavolcanics. Pyrrhotite is also found as disseminations in the metavolcanics, but is less abundant than pyrite. Massive arsenopyrite is found concentrated in one area in McCubbin Township.

Sand and gravel deposits are fairly extensive in McCubbin Township, and several pits have been excavated by the Ontario Department of Highways for the construction of Highway 599.

No mineral deposits of production grade have yet been found, although some of the showings have received considerable attention.

History

Savant Lake and the vicinity has had a long history of intermittent mineral exploration. The earliest records show that prospecting for gold began about 1900, and the search for this precious metal continued until recently when base-metal exploration became the main target. During these earlier years, the area experienced two minor gold rushes in 1926 and 1940 respectively. Before 1950,

base-metal exploration was nonexistent in the area. However, since 1968, the entire region has received considerable attention, and this is most probably a reflection of the discovery of the Mattabi Mine on Sturgeon Lake 44 miles (70 km) to the south.

Mineralized Quartz Veins

Except for the felsic to intermediate metavolcanics, secondary quartz is widespread throughout the succession. Although the majority of the quartz showings are barren of potentially economic minerals, quartz veins are associated with all the main mineral showings found in the area. Moore (1928, p.68-72) also recognized this, and gave a good account of the quartz veins.

The quartz occurs as discontinuous lenses, veinlets, stringers and veins ranging in width from a fraction of an inch up to a maximum of 10 feet (3.1 m). The largest vein is exposed on the western shore of a small island just west of a point on the central-eastern shoreline of Virginian Lake in southeastern McGillis Township. Only the northwesterly trending quartz vein in northwestern McGillis Township, approximately 1 mile (1.6 km) east of the shore of Savant Lake, is discordant to the country rocks. All the remaining major quartz zones appear to have a more or less concordant relationship with their host rocks. Wherever possible, the silica-rich fluids seem to have taken advantage of zones of weakness, for example, contact zones between mafic to intermediate pillow lavas and massive flows. Shear zones were commonly injected with quartz veins. This latter feature is especially prevalent in the mafic to intermediate metavolcanics.

No structures or observations exist to indicate that these quartz veins were syngenetically related to their host rocks. This fact supported by the presence of the shearing suggests that the quartz veins are secondary in origin, and probably related to the regional metamorphism.

Many of the quartz vein showings are composed of multiple veins, some of which are discontinuous and offset in an *en échelon* fashion. Pyrite is commonly disseminated in the adjacent sheared country rocks. Magnetite is present along with the pyrite in some zones. Carbonate is locally present. Sulphide minerals are commonly associated with the quartz veins and several sulphide showings are discussed below.

Approximately 1 mile (1.6 km) east of the northeastern part of Savant Lake and 1.75 miles (2.8 km) north of Hazel Lake in McGillis Township, malachite and marcasite (or weathered pyrite ?) are associated with a quartz vein. The vein, 2 feet (0.6 m) wide, strikes northeast, and is only traceable for about 40 feet (12 m). The quartz vein occurs in mafic to intermediate pillow lavas. A sample taken by the author and analyzed by the Mineral Research Branch of the Ontario Division of Mines was found to contain 0.14 percent copper.

Pyrite and pyrrhotite are found in a shear zone in mafic to intermediate metavolcanics on a small island midway on the western shore of Virginian Lake (Map 2357, back pocket). The northerly trending shear zone dips at 55 degrees to the west. A selected sample taken by the author and assayed by the Mineral Research Branch of the Ontario Division of Mines revealed only traces of copper.

Minor sulphide minerals (mostly pyrite) in iron formation are exposed in two test pits located about 400 feet (120 m) from the extreme northeastern shore of Savant Lake in northern McGillis Township (Map 2357, back pocket). This test pit zone was described by Moore (1928, p.72-73). The iron-formation is discontinuous and trends north-northeast with a near vertical dip. According to Moore (1928), a selected specimen taken by either himself or the individuals doing the work at that time returned an assay value of 2.76 percent nickel. A sample taken during the present survey, when assayed by the Mineral Research Branch of the Ontario Division of Mines contained only traces of nickel and copper.

Approximately 500 feet (150 m) east of Silver Lake in southeastern McGillis Township, disseminated sulphide minerals (mostly pyrite, minor pyrrhotite, chalcopyrite) were found in a massive mafic to intermediate metavolcanic flow. The area is close to a diamond-drill hole (not shown on Map 2357, back pocket) completed by Dome Exploration (Canada) Limited. A grab sample, taken by the author and assayed by the Mineral Research Branch of the Ontario Division of Mines disclosed only trace amounts of copper.

Massive arsenopyrite is exposed in several test pits located approximately 2,000 feet (600 m) west of Highway 599 and 4,000 feet (2400 m) north of Wiggle Creek near the centre of McCubbin Township. The history of development of this showing remains unknown because no work was ever filed for assessment credits. The sulphide minerals are associated with a quartz-rich zone which is exposed for 300 feet (90 m) and may be part of a quartz vein that is on strike located 1,000 feet (300 m) to the west of this mineralized zone. Only minor pyrite is associated with the more westerly showing. Three test pits have been blasted out of the main showing. The mineralization is associated with several quartz veins emplaced in metasediments composed of greywacke, sandstone, and iron formation. The metasediments strike at approximately N80°E and their dip is from vertical to 85° to the southeast. The main quartz vein which is 8 inches (20 cm) wide, trends N95°E and dips 70° to the northeast. While the mineralized zone including quartz and carbonate veins, veinlets and stringers are up to 12 feet (3.7 m) wide the main mineralized zone is 2 feet (0.6 m) wide at the maximum, and thickens and thins discontinuously along its 100 feet (30 m) strike length. Massive arsenopyrite and lesser amounts of massive pyrite are present. Although no visible gold was observed, a selected sample of the massive sulphide minerals taken by the writer, when assayed by the Mineral Research Branch of the Ontario Division of Mines contained 0.22 ounce of gold per ton for a value of $7.70 per ton according to the 1971 prices.

Iron

Magnetite is the chief iron ore mineral in iron formation units interlayered with the metasediments. This metamorphosed iron formation has already been described (see section on "Metamorphosed Iron Formation"). The quality of the iron formation is dependent upon the number of beds present over a given area as well as the number of magnetite laminae with each of the individual beds. The thickest beds of iron formation are concentrated near the nose of the fold on

the western shore of Savant Lake in Poisson Township. The richest area containing the most iron formation units (volumetrically) is the folded sequence of ferruginous metasediments in southwestern McCubbin Township and this area has received the most attention from prospectors. The percentage of magnetite lamellae varies irregularly throughout the ferruginous metasedimentary sequence. Three samples taken by the author from the ferruginous metasediments near the western shore of Savant Lake, and from the sequence underlying southwestern McCubbin Township, when assayed by the Mineral Research Branch of the Ontario Division of Mines, ranged from 26.0 to 34.1 percent total iron.

Description of Properties

THE ALGOMA STEEL CORPORATION LIMITED [1967] (1) and (4)

On June 3, 1955, Pershland Gold Mines Limited acquired from Wiggle Creek Prospecting Syndicate 19 unpatented claims in southwestern McCubbin Township, south of Kashaweogama Lake. Part of the claim block is also in northwestern Conant Township to the south of McCubbin Township, and part of the claims are also in the area lying to the west of Conant Township and McCubbin Township. The property is underlain by iron formation and arenaceous metasediments.

The deposit was first examined by Collins (1907) and later, and in more detail by Moore (1910; 1928). In 1908, some test pits were dug and stripping was done, and in one place a shaft was sunk for 15 to 20 feet (4 to 6 m) by a United States-based company on the southern shore of Kashaweogama Lake west of McCubbin Township. In 1921, a magnetometer survey and a dip needle survey (Assessment Files Research Office, Ontario Division of Mines, Toronto, File 63.2932) were done over the area to see if there was any lateral continuity to the iron formation. This survey was done along 26 lines run across the lake with measurements of the intensity being taken at intervals of approximately one chain (66 feet; 20 m). All of that part of Kashaweogama Lake within McCubbin Township was covered, but the survey also extended further west out of the map-area. The surveys showed that the zone of iron formation in southwestern McCubbin Township was not continuous with the band of iron formation near Snowbird Lake (see Map 2357, back pocket).

No further work was recorded on the property until 1955 when Pershland Gold Mines Limited acquired 151 mining claims in the area from an unknown syndicate. Beginning in early 1956, Pershland Gold Mines Limited did considerable trenching, drilled four short test holes (138 feet; 42 m) on claim TB62234, and did a dip needle survey over the area. Favourable results initiated further exploration work, and in 1957, Sharpe Geophysical Surveys Limited carried out a ground magnetometer survey (Assessment Files Research Office, Ontario Division of Mines, Toronto, File 63.909) for Pershland Gold Mines Limited on 56 claims grouped near the extreme southwest corner of McCubbin Township. Of these claims, only claims TB62236-62241 inclusive and PA17016, 17017 inclusive lie within the map-area. A sharp vertical-force magnetometer was used.

Grid lines were cut at intervals of 400 feet (120 m) over the property and observations were taken at intervals of 100 feet (30 m) and at 50-foot (15 m) intervals in anomalous zones. The results showed the strongest magnetic attraction to be situated in the extreme southwestern part of McCubbin Township in the eastern part of the property and indicated a band of iron formation between 400 and 700 feet (120 to 210 m) wide with a strike length of at least 3,000 feet (900 m). Figure 2 is a plan showing the results of a magnetometer survey and location of the diamond drill-holes on the property.

From the magnetometer survey it was concluded by A.E. Cowles in a Pershland Gold Mines Prospectus (page 1) dated April 25, 1957 and held in the Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora, that:

> An extensive anomaly over the magnetite which indicated approximately 820,000 long tons per vertical foot for the wider sections and 300,000 long tons per vertical foot for the narrow sections. It is estimated that the wider sections can be mined by open pit to a depth of 500 feet [150 m] and the narrow sections to a depth of 300 feet [90 m]. If the magnetite is of the same size at these depths as at the surface, the wider areas calculate to 410,000,000 long tons to 500 feet [150 m] and the narrow widths to 90,000,000 long tons or a total of 500,000,000 tons using a factor of ten cubic feet per long ton.

No mention is made of grades here, although on page 2, the report stated that initial assays averaged slightly over 30 percent iron oxide. The above reported tonnages appear to be somewhat speculative. Further testing was recommended by this same report.

Also, in 1957 further diamond drilling was accomplished and the positions of these are shown in Figure 2. Hole number 1 in Figure 2 was drilled at 45 degrees due south and ended at a depth of 756 feet (230.4 m) in magnetite. The first 240 feet (73 m) of the diamond-drill hole was in magnetite and metasediments, but below this, the iron content increased more favourably. Hole number 2, which was started in an area of higher magnetic intensity than hole number 1, intersected over 500 feet (150 m) of magnetite and terminated at 752 feet (229.2 m) in magnetite. A total of 8 holes were drilled but only five (total length 3,002 feet; 915.3 m) were submitted for assessment credits (Assessment Files Research Office, Ontario Ministry of Nautral Resources , Toronto, File 63.2036, page 2.). Hole number 3 was abandoned in overburden. The five holes in order were drilled for distances of: 756 feet (230.4 m); 752 feet (229.2 m); 45 feet (13.7 m); 751 feet (228.9 m); and 698 feet (212.8 m), respectively.

All but 21 of the original claims were allowed to lapse. In 1960, Pershland Gold Mines Limited optioned the remaining claims to Caland Ore Company Limited who drilled four diamond-drill holes for a total length of 2,262 feet (689.4 m) in August and September of that year. All four diamond drill holes were located just outside McCubbin Township in the iron formation body. In 1965 Pershland Gold Mines Limited conducted a more detailed magnetometer survey (Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63.2036) as well as a geological mapping program on the 20 claims in order to have more control for any future drilling program. The readings in the detailed magnetometer survey were taken every 25 feet (7.6 m) along gridlines spaced at 100-foot intervals (30 m), and the survey covered only a part of the 1957 magnetometer survey. The survey utilized a Sharpe MF-1 Fluxgate Magnetometer. It was concluded that further drilling and test work were required before it would be possible to determine the economic potential of the

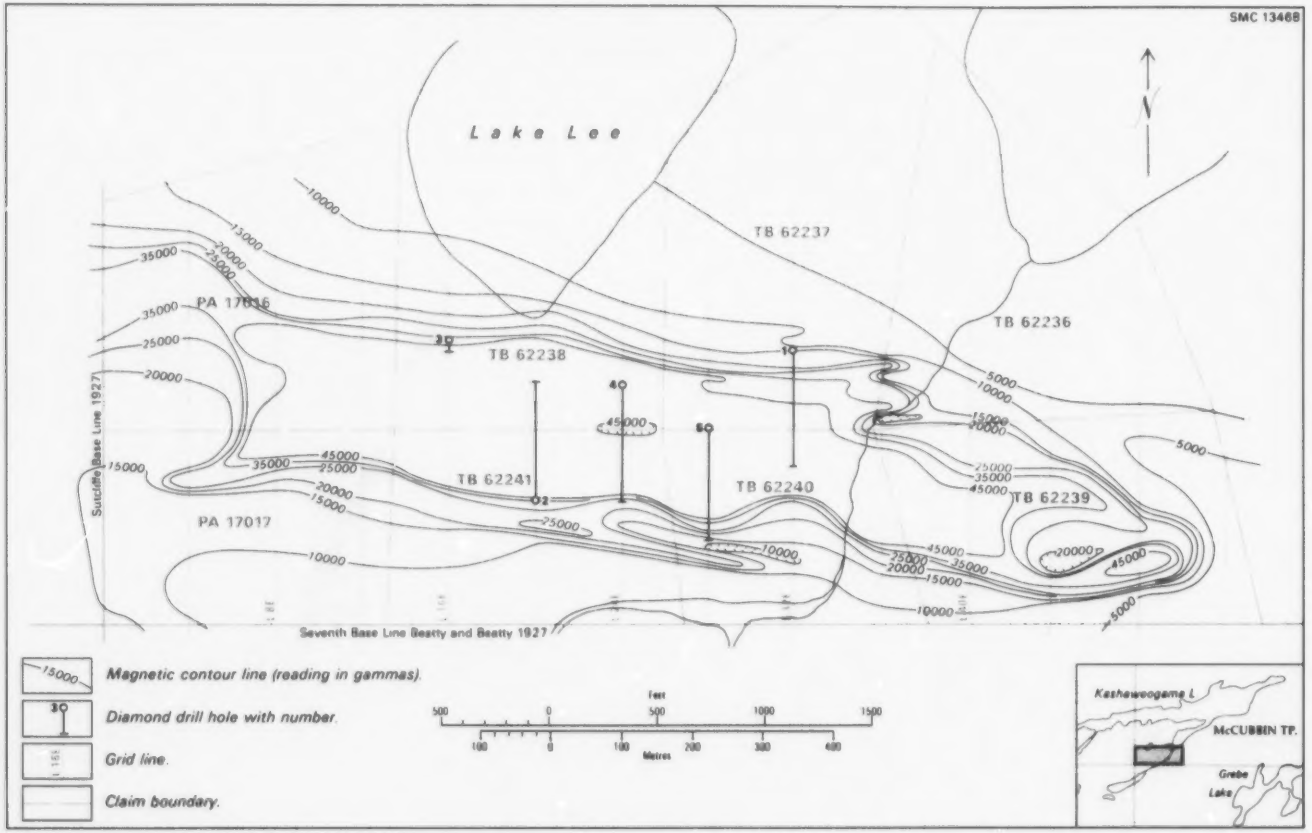


Figure 2–Map showing Magnetometer Survey in 1957, and location of five diamond-drill holes drilled by Pershland Gold Mines Limited (from Assessment Files Research Office, Ontario Division of Mines, Toronto, File 63.909).

iron ore deposit. In 1967 the property was optioned to the Algoma Steel Corporation Limited. Many of the above gridlines and diamond-drill holes in the eastern part of the property, that part lying in the southwestern corner of McCubbin Township, cannot be located because the area has been extensively logged during the years 1970-1971. The property is however, easily reached using the several logging roads which now traverse the area.

In 1967, the Algoma Steel Corporation Limited acquired from Pershland Gold Mines Limited, 21 claims encompassing the iron formation body in the extreme southwestern part of McCubbin Township. The claims included:PA 38268-38285 inclusive, PA 36857, and PA38303-38304 inclusive.

A magnetometer-geophysical survey (Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63.2159) was conducted to outline further the magnetic anomaly previously located by an airborne magnetometer survey and to confirm widths of sections previously determined by Pershland Gold Mines Limited in 1957 (Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63.909). The survey was run on a grid system cut at 200-foot (60 m) intervals and in some places 100-foot (30 m) intervals where more detailed information was required. The survey utilized a McPhar M-700 Fluxgate Magnetometer with readings being taken at 25-foot (7.6 m) intervals. A geological survey was done (Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63a-529) although the bedrock is poorly exposed. Figure 3 is the geological interpretation of the area by the Algoma Steel Corporation Limited using the results of the magnetometer survey and the diamond-drill logs of the holes drilled (3,140 feet; 942.6 m) by Pershland Gold Mines Limited in 1956 and 1957. Figure 3 shows that the highest concentrations of iron occurs as broad iron formation bands (map unit 3, Figure 2) within the metasediments (map unit 5, Figure 3). The claims were allowed to lapse in 1971.

During the 1940s, Northern Canada Mines Limited conducted an extensive exploration program encompassing much of the Savant Lake area. The first discovery was made in early September 1940 by two officials of the Northern Canada Mines Limited named Mosher and Garvey. The two prospectors discovered gold on the eastern side of One Pine Lake; the lake is also sometimes referred to as Lone Pine Lake in the early geological company reports. There is a well cut portage approximately 2,000 feet (600 m) in length into the lake beginning at the old cabin located 1 mile (1.6 km) north of the narrows on the west side of Savant Lake. The events that followed were well documented in the Northern Miner-(1940 a,b,c,d,e,f,g).

The main showing is located 350 feet (110 m) east of One Pine Lake in southwestern Poisson Township where a shear zone is traceable for 250 feet (76 m). The shear zone which trends north-northeast and dips 80 degrees to the southeast is concordant to its metasedimentary host rocks. The shear zone, exposed for 250 feet (76 m) is marked by discontinuous quartz and minor carbonate veins, veinlets and stringers. Concentrations of massive and euhedral pyrite layers are interbedded with iron formation and greywacke. Although the original find was reported to have been extended to nearly 2,000 feet (600 m) (Northern Miner 1940b), no evidence of lateral continuity of the zone was observed in the field by the author. Initial assays of selected samples by the company employees

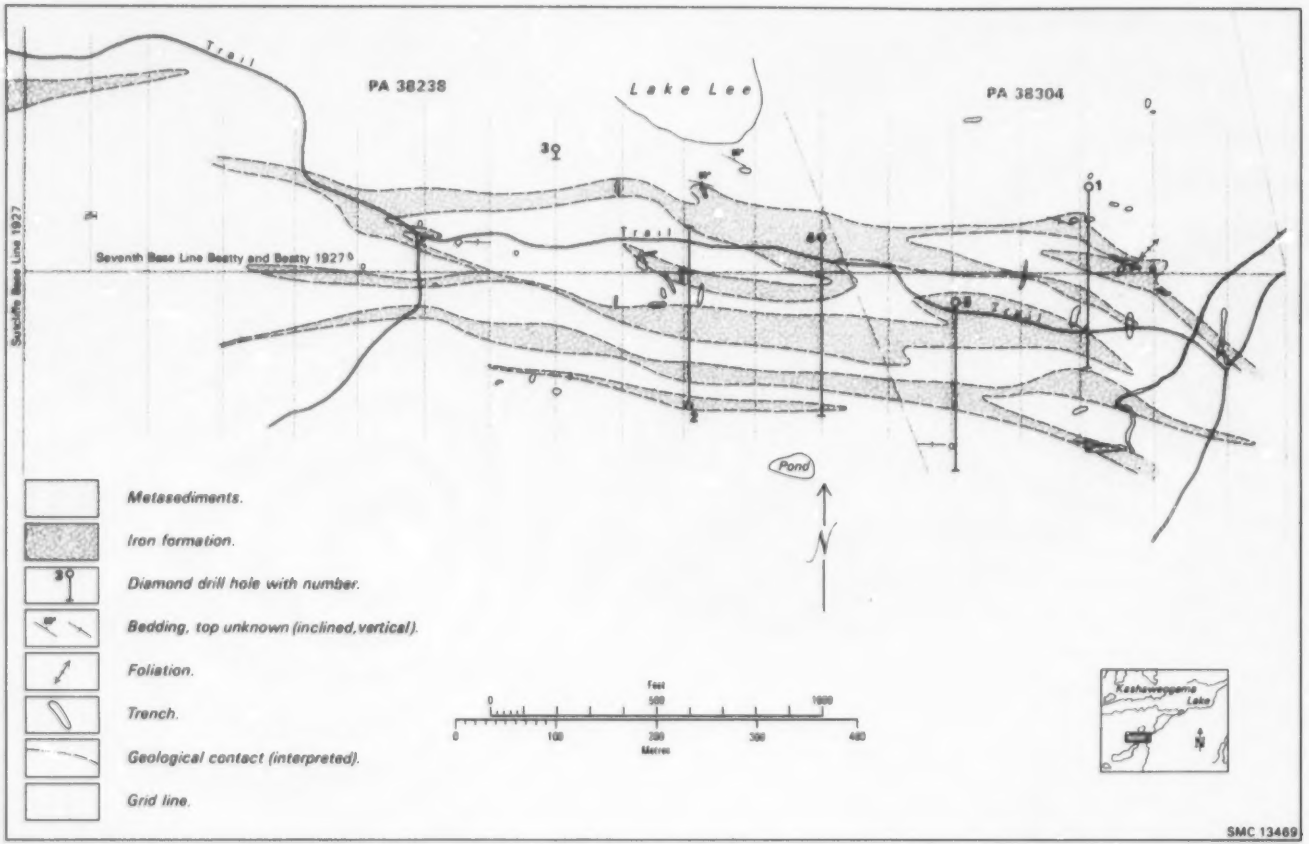


Figure 3–Geological interpretation of the iron formation zone south of Kashaweogama Lake in southwestern McCubbin Township; after Paul Leahy, Geologist, Algoma Steel Corporation Limited (from Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63A.529).

ran as high as 3 ounces of gold per ton (Northern Miner 1940b). No visible gold was observed in the quartz and this was confirmed by assay results of samples taken by the author. According to the Northern Miner (1940c):

> The quartz carries little or no gold. Though no visible gold shows, values in ounces have been had from character samples of the pyrite sections. Where that mineral is sparse, values are low.

The main sulphide-rich zone is 5 inches (12.5 cm) in width and is traceable for approximately 15 to 20 feet (4.6 to 6 m). Selected samples taken by the author containing pyrite and iron formation, when assayed by the Mineral Research Branch of the Ontario Division of Mines, gave values of 0.24 and 0.43 ounce of gold per ton.

In September 1940, the discovery led to the biggest staking rush that Ontario had experienced in several years (Northern Miner, September 1940b). The original discovery was made about 300 feet (90 m) east of the shore line of One Pine Lake (Northern Miner 1940a). At that time, the discovery zone was found to extend for about 2,000 feet (600 m) (Northern Miner 1940b) in a north-northeast trend, although this lateral extension was not found during the present mapping. A second discovery was made soon after and much of the surrounding area was staked by numerous mining companies (Northern Miner 1940b,e). The second showing was located approximately 1 mile (1.6 km) to the west of the original discovery. Two trenches that probably originated at that time were found during the present mapping, and are located midway between One Pine Lake and Snowbird Lake. The trenches, which are caved in and largely overgrown, are poorly exposed. Essentially the original discovery was located near a shear zone with an associated quartz vein in iron formation-bearing metasediments. The gold was found intermixed with the sulphide minerals while the quartz produced only low values of gold (Northern Miner 1940c). Four test pits were blasted out in the original discovery area and showed the mineralized, quartz-bearing zone to be 12 to 14 feet (3.7 to 4.3 m) wide (Northern Miner 1940d). Several of the surrounding claims reported gold-bearing quartz veins and veinlets (Northern Miner 1940d,e). Northern Canada Mines Limited decided to diamond-drill the initial showing (Northern Miner 1940f). The work in 1940 was summarized by the Northern Miner (1940g):

> Approximately 95% of the work done at Savant Lake was completed on the 25-claim group embracing the original discovery. This showing consists of a highly altered mineralized zone, associated with iron formation in the sediments. The values are contained in the sulphide mineralization and the quartz itself does not carry.
>
> ...sampling of three trenches covering a length of 80 feet [24 m] north from the original discovery at the lake shore gave an average of $9.00 across 4.7 feet [1.4 m].
>
> Some distance to the west of the original find a series of narrow quartz veins were found which appear to persist over a length of 4,000 feet [1,200 m]. Visible gold is in evidence in the quartz but the wallrock doesn't carry appreciable values. One of these quartz veins showing a width of two to five inches [5 to 13 cm] was stripped for a length of 68 feet [20 m] and sampled to show an average of $21.80 across 0.73 feet [2.2 m].

At that time the value of an ounce of gold was $20.67. Evidence of stripping was found in the area, and while some secondary quartz veins were observed in the field during the present survey, no visible gold was seen by the field party. The two trenches shown on the preliminary map of Poisson Township 4,000 feet (1200 m) southwest of One Pine Lake were probably excavated at this time. Ac-

cording to the Northern Miner (1941), Northern Canada Mines Limited diamond-drilled 3,512 feet (1070.5 m), but no record of this was found in the assessment files. The results were published in the Northern Miner (1941) as follows:

> Eight holes were drilled on the No. 1 zone, the scene of the original find on the One Pine Lake group. Holes drilled under the surface exposure cut quartz stringers at a vertical depth of about 50 feet [15 m] but in all cases assays were low. Three of the holes, however, showed a stringer structure lying 50 feet [15 m] to the west of where the projected downward extension of the surface showing would be expected. These intersections may represent an altogether new zone or the surface showing may have taken a very flat roll to the west.
>
> The first hole cut the stringer structure, lying 50 feet [1.5 m] west of the vertical downward projection of the surface outcropping, at an incline depth of 156 feet [54 m] where 2.2 feet [0.7 m] of vein matter assayed 0.01 oz. followed by 1.5 feet [0.46 m] assaying 0.76 oz. Five feet [1.5 m] of sludge covering these two intersections assayed 0.53 oz. Along strike the extension was cut in a hole drilled 50 feet [15 m] to the northeast but assays were low grade. The extension 50 feet [15 m] to the southwest, was cut in a hole which gave consecutive assays of 0.14 oz. across 1.4 feet [0.43 m], trace across 2 feet [0.6 m], 0.05 across one foot [0.3 m], trace across 1.2 feet [0.4 m], and 0.07 oz. across 1.3 feet [0.4 m]. Low grade stringers were encountered in a hole spotted to cut the structures at the 150-foot [46 m] horizon at a point just southwest of the hole which gave the best values.
>
> Two short holes were drilled north of this point to test for a northerly extension of some auriferous pyrite occurring at the shore but these holes returned no intersections of interest.

In June 1966, The Algoma Steel Corporation Limited staked a group of claims in the vicinity of One Pine Lake to evaluate the iron potential of the iron formation. The claims were referred to as the "Snowbird Lake" claims and included the following unpatented claims: PA36858, PA36861, PA36803, PA36866, PA36869, and PA38122-38177 inclusive.

The claims are underlain entirely by metasediments composed of greywacke-sandstone, siltstone, iron formation and minor cherty medasediments. A magnetometer survey was run (Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63.2151) on a 400-foot (120 m) (in places 200 feet; 60 m) grid system using a McPhar M-500 Fluxgate Magnetometer. Two anomalous areas approximately 6,000 feet (1,800 m) and 150 feet (46 m) in width were outlined. This was followed by geological mapping at a scale of 1 inch to 200 feet (1:2,400) of the area covered by the six claims PA 38173-38177 inclusive and PA 36861 (Assessment Files Research Office , Ontario Ministry of Natural Resources, Toronto, File 63.2151). The anomalies were related to the underlying ferruginous metasediments. G.B. Thorsteinson, geologist for the Algoma Ore Division reported (Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63.2151):

> The greywacke is the country rock for the iron formation; with few exceptions iron formation bands make up no more than 15-20 percent of any particular outcrop. The greatest width of iron formation observed was about 20 feet [6 m]. Great widths of altered greywacke with minor iron formation bands and small quartz stringers were the most common outcrops observed.
>
> Individual iron formation bands generally vary from laminae to one foot [0.3 m] widths but most fall in the one inch to five inch range [2.5 to 12.5 cm].

The claims were allowed to lapse in 1971.

AMALGAMATED RARE EARTH PROPERTIES LIMITED (8)

In an agreement dated August 24, 1971, Amalgamated Rare Earth Mines Limited acquired 23 unpatented claims and a 95 percent interest in another 14 unpatented claims in the Savant Lake area. The majority of these claims are located south of the southeastern part of McGillis Township in Smye Township (Bond 1973c). Of these 37 (total) claims, only 8 claims are wholly or partly contained within the map-area and these are: PA254512-254515 inclusive, PA285927, PA285970-PA285972 inclusive.

A base-metal showing occurs on that part of the property situated south of McGillis Township, and attention was focused mainly on this part. The showing and the property is described in the geological report of the area (Bond, in press).

During January and February, 1971, a grid system of lines was cut at 400-foot (120 m) intervals. A combined Ronka 16 electromagnetic survey was done over the claims with readings being taken at 50-foot (15 m) intervals (Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto, File 63.2922). The work is being done by Mid-North Engineering Services Limited. Some good electromagnetic conductors with associated strong magnetic anomalies were found in the northeastern part of the property, but these are situated to the south of McGillis Township and are described in the author's later report of Smye Township (Bond, in press).

M. CADDELL (5)

Morris Caddell staked a large block of claims on and along the western shore of the main part of Savant Lake in Poisson Township. The 74 claims involved were staked in February 1969 and included: PA46067-46096 inclusive, PA47127-47129 inclusive, and PA210197-210217 inclusive. These claims expired on April 30th, 1970, but 12 of them were restaked and included PA309179-309190 inclusive.

The claims, which are located over a strong magnetic high as defined on the regional aeromagnetic maps (ODM-GSC 1961a, 1961b) were staked in order to evaluate the iron potential. According to the geophysical report done by Angus G. Mackenzie, official for Mining Consultants Limited, the claims were submitted as assessment credits (Assessment Files Research Library, Ontario Ministry of Natural Resources, Toronto, File 63.2805), the area has been staked many times. In July 1969, a geophysical survey was conducted on a grid with grid lines spaced at 400-foot (120 m) intervals over the northern part of the property. Readings were taken at 100-foot (30 m) intervals with a Sharpe Magnetometer, Model A-3. Faulting was interpreted to be present in parts of the property by M. Caddell based on the geophysical survey, but in fact, the persistence of the iron formation, as noted in the above report (File 63.2805) would appear to conflict with his interpretation. A semi-detailed geological survey and further, a more detailed magnetic survey accompanied by diamond drilling were recommended as follow-up procedure.

During the 1971 field season, M. Caddell carried out a more detailed magnetometer survey over grid lines spaced at 200-foot (60 m) intervals on the same property, but to date, the results of this survey have not been submitted for assessment credit. The claims were in good standing as of December 1971.

DOME EXPLORATION (CANADA) LIMITED (9)

In 1970, Dome Exploration held three blocks of unpatented claims in McGillis Township. The three claims groups are located (1) on the east-central shoreline of Savant Lake, (2) just northeast of Leggo Lake, and (3) between Silver and Virginian Lakes. A total of 68 claims were staked and included: PA47019-47036 inclusive, PA210123-210126 inclusive, and PA210129-210148 inclusive.

Although initial work must have been done to spot favourable areas, only the diamond-drill logs were submitted to the Ontario Division of Mines for assessment credits (Assessment Files Research Office, Ontario Division of Mines, Toronto). Nine diamond-drill holes were sunk for a total length of 2,617 feet (798 m) on claims PA47028, PA47035, PA47097, PA210086, PA210090, PA210092, PA210136,(three holes were spotted and drilled on claim 210136). The diamond-drill holes were not located in the field and are not shown on Map 2357, back pocket.

All the rocks intersected were mafic to intermediate metavolcanics containing minor quartz-carbonate veins and silicified zones. Visible mineralization was most often found closely associated with these siliceous zones, and took the form of disseminated pyrite, and pyrrhotite, with minor specks of chalcopyrite. The diamond-drill hole located on claim PA47097 immediately north of the central part of Leggo Lake proved to be the best intersection. These, according to the records submitted as assessment credits included a 22.8-foot long (6.9 m) (a depth of 139.2 feet to 162 feet; 424 to 49.4 m) siliceous zone in hole 19-18-21-1 on claim PA47097 containing massive to disseminated pyrite, pyrrhotite with minor chalcopyrite which assayed from 0.11 to 0.6 percent copper and up to 0.15 percent zinc (Assessment Files Research Office, Ontario Division of Mines, Toronto) The claims were in good standing in September 1971.

THE INTERNATIONAL NICKEL COMPANY OF CANADA LIMITED (2)[1]

In 1967, The International Nickel Company of Canada Limited undertook an extensive exploration program covering much of the Savant Lake area. Geophysical and geological work were done on anomalous areas which were probably picked up by an airborne survey, although this work is not on file in the Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto. Extensive diamond drilling was done during this period by the company (see Files in Assessment Files Research Office, Ontario Division of Mines, Toronto). Within the boundary limits of this geological survey the company held two

[1] This ground is owned by the Canadian Nickel Company Limited, a wholly owned subsidiary of The International Nickel Company of Canada Limited.

blocks of claims both situated in McCubbin Township. The larger claim block of the two was located south of the eastern end of Kashaweogama Lake and included 53 claims: PA38771-38779 inclusive, PA39408-39415 inclusive, PA39462-39468 inclusive, PA39471 -39478 inclusive; PA39481-39488 inclusive, PA226994-226697 inclusive, and PA244443-244447 inclusive. These claims are located over a magnetic anomaly arising from the presence of extensive underlying deposits of iron formation-bearing metasediments.

The second claim group was located in northeastern McCubbin Township in the vicinity of Highway 599 and included 12 claims: PA38615-38618 inclusive, PA38628-38631 inclusive, and PA39469, PA39470, PA39479, PA39480. This northern claim block is underlain by predominantly mafic to intermediate metavolcanics.

Twelve diamond-drill holes were located on the basis of ground geophysical survey data. The diamond-drill holes were not located during the present mapping program, and are not shown on the accompanying map of the area. A total of 4,254 feet (1,296.6 m) were drilled on claims PA38615, PA38631, PA38771, PA38772, PA39412, PA39413, PA39462, PA39471, PA39476, PA39482, PA39483 and PA244447. The most common rocks intersected were metasediments (greywacke, iron formation) but some metavolcanics were also encountered in the north. One diamond-drill hole near the contact of the Grebe Lake Stock intersected only granitic rock. No noteable mineralization was reported, although disseminated pyrite and pyrrhotite were commonly noted in the drill core. The diamond-drill hole on claim PA38615 in the northern claim block near the granitic stock in northeastern McCubbin Township went to a depth of 151.5 feet (46.2 m) and intersected 48.5 feet (14.8 m) of quartz-magnetite iron formation in predominantly mafic to intermediate metavolcanics. In October, 1971, the claims were still in good standing.

McRAE-SIMMONS OCCURRENCE (6)

Visible gold was found in selected hand specimens from the excavations of several test pits on the small island located ½ mile (0.8 km) southeast of the centre of Girard Island. This showing has been previously mentioned as the "McRae-Simmons Property" (Moore 1928, p.76-77). It is an old showing, and the geology has been partly obscured by the newly grown extensive overgrowth. The gold is associated with quartz situated in a vertical shear zone trending N70°E. The shear zone is only evident on the northeastern shore of the island and must die out before reaching the southwestern (opposite) shore of the island. A 15-foot (4.6 m) shored shaft was sunk, but little can been seen because the shaft is flooded. Moore's (1928 p.76-77) description is as follows:

> This property is controlled by a syndicate of New Liskeard prospectors and includes a group of claims on the islands in the southeastern portion of the main section of Lake Savant. It was on one of these isalnds that the only spectacular occurrence of native gold reported from the Savant area was found. This outcrop may be seen on the point of the island at the water's edge, but no gold was visible in it at the time of the writer's visit to the property. Several veins have been uncovered, and a large amount of test-pitting has been done on several of the islands. The Noranda interests took an option on the property during the winter of 1926-27 and performed considerable work in testing it. Camps were built on one of the islands, but after several months' work the option was given up.
>
> Near the camps on the island there are several test pits in sericite schists interbanded with pillow lavas, which show lenses of milky white quartz as much as 15 inches [38 cm] in width. The quartz

contains pyrite and chalcopyrite, and a few fragments of quartz showed native gold. The individual veins are short, not over 1½ chains [30 m] in maximum length. The "discovery" vein, which outcrops on an island to the east of the one on which the camps are located, runs northwest across the general strike of the greenstones, which is N75-80E in this locality. This vein could be followed from one island to another for a distance of about 10 chains [200 m]. Its width reaches a maximum of 2 feet [0.6 m] but most of it is between 6 and 10 inches [15 to 25 cm]. Several pits in rusty schist cut by the vein show that the vein and the schists are impregnated with arsenopyrite. Most of this mineral is in distinct crystals scattered through the schist on either side of the vein, in one place over a width of 6 feet [1.8 m], and there is little of the massive fine-grained mineral in the rock. No visible gold was found by panning the rusty schist. The main pit sunk by the Noranda company is about 6 feet [1.8 m] square and nine feet [2.7 m] deep. It was put down in rusty schists cut by stringers of quartz running in all directions through it. In the quartz and adjacent schists there is a considerable carbonate, a little pyrite and chalcopyrite, and much arsenopyrite. The arsenopyrite is abundant through a zone 6 feet [1.8 m] wide.

The main shear zone, with which the gold tailings are associated, is concordant with the surrounding pillow lava host rocks, but the quartz vein-bearing shear zone to the southeast (referred to as the "discovery vein" by Moore 1928) is discordant, and trends northwest across the regional trend. Only euhedral pyrite grains were found in the sheared host rocks. Visible gold and chalcopyrite were found as local blebs in the milky-white quartz. A selected hand specimen taken by the author with easily visible gold and chalcopyrite was assayed by the Mineral Research Branch of the Ontario Division of Mines and contained 6.72 ounces of gold per ton, 0.54 ounce of silver per ton, and 0.12 percent copper.

NORANDA EXPLORATION COMPANY LIMITED (7)

The Noranda Exploration Company Limited held title to a 20-claim group (PA286881-286900 inclusive) on the northern part of Girard Island in Poisson Township. During 1971, seven of the claims were allowed to lapse while a combined electromagnetic and magnetic survey (Assessment Files Research Office, Ontario Ministry of Natural Resources, File 2.678) was accomplished on the remaining 13 claims of the property: PA286882, PA286886-286888 inclusive, PA286891-286895 inclusive and PA286897-286900 inclusive.

The survey was made on a grid with grid lines spaced at 400-foot (120 m) intervals over most of the property, and in more detail over a 200-foot (60 m) grid system in the northeastern part of the property. The electromagnetic survey was carried out employing a Junior Electromagnetic Unit and the magnetometer survey was accomplished using a McPhar Fluxgate Magnetometer. The readings of the latter were taken every 100 feet (30 m), but were reduced to 50-foot (15 m) intervals over anomalous zones. Four anomalous zones were found: three of these were ill-defined, broad areas of conductivity while the other was a defined conductor with a northeasterly axial trend. The anomalous zones are of local extent, 200 to 400 feet (60 to 120 m) in length, but appear to be aligned with one another, and may in fact be connected forming one continuous trend over 3,200 feet (970 m) in length. All of the electromagnetic trends are situated over flat magnetic areas shown by the magnetic survey. The trend of the anomalous zone coincides with the stratigraphy of the underlying mafic to intermediate metavolcanics. A definite magnetic trend was found, however, and the cause was not known. However, the present mapping shows this magnetic zone coincides with

an underlying medium- to coarse-grained metavolcanic flow which contains abundant disseminated magnetite. Recommendations were made for a further vertical loop survey to be done to determine the true nature of their conductivity. The claims were in good standing in December 1971.

E. PRIESTON [1971] (3)

The claims that the Algoma Steel Corporation Limited held in the extreme southwestern corner of McCubbin Township expired, and in 1971 Mr. Ernest Prieston of Thunder Bay held two claims: PA277076 and 277077 in the vicinity. No work was ever filed for assessment credits, and although the claims were in good standing in October 1971, the claims were allowed to lapse in the spring of 1973.

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